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ABSTRACT

This study evaluated the impact of the Australian Science Education Project (ASEP) which, during 1969-1974, produced learning materials for secondary school science courses. The extent to which ASEP materials had been adopted and used by secondary schools, variation in adoption and use between states and factors associated with this variation, implementation of ASEP ideas and materials in schools, and factors affecting implementation were examined. Methodology included surveys of about 300 schools and case studies of selected state educational systems and schools. Findings indicated that about two-thirds of Australian schools adopted ASEP materials within two years of their publication, large variations in levels of adoption occurred between schools and that the state in which the school was located was associated with variation in adoption. High levels of adoption were related to teacher access to ASEP ideas/materials, to availability of curriculum guidelines sympathetic to ASEP rationale, and to encouragement for schools to change their curricula. Implementation was also related to climate of innovation in science departments. Findings suggest that effective dissemination and implementation require continuous system-level support and that users possess certain attributes, including receptivity to change, cooperation between schools, and effective organization of materials and facilities. (Author/JN)

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THE AUSTRALIAN SCIENCE EDUCATION PROJECT - A STUDY OF FACTORS AFFECTING ITS ADOPTION AND IMPLEMENTATION IN SCHOOLS

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1979

SE 037666

This thesis is based upon original research conducted by the author as a student of the Faculty of Education in Monash University from October 1975 to September 1979.

I hereby declare that this thesis contains no material which has been accepted for the award of any degree or diploma in any university and that it contains no material written by another person, except when due reference is made in the text of the thesis.

John Maxwell Owen

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Qui Patitur Vincit

John Maxwell Owen

ABBREVIATIONS

Names of Australian States

ACT	Australian Capital Territory
NSW	New South Wales
VIC	Victoria
QLD	Queensland
SA	South Australia
WA	Western Australia
TAS	Tasmania

Other abbreviations used are explained in the text.

ABSTRACT

This study set out to evaluate the impact of a curriculum innovation in secondary schools. The innovation was the Australian Science Education Project which, during the period 1969 to 1974, produced learning materials for use in science courses. The Project was the first national curriculum development mounted in Australia; it was funded to a total of $A1.4 million and supported by the Federal and all State Governments.

The study encompassed four main aspects: the extent to which ASEP materials had been adopted and used by secondary schools, the variation in adoption and use between States and the factors associated with this variation, and the implementation of ASEP ideas and materials in schools and the factors affecting implementation.

A variety of methods was used in the study. A survey of about 300 schools was conducted and the datawere used to assess the extent of adoption and use of ASEP materials. In addition data about State and school variables which affected the adoption and implementation was collected by this means. A complement to this large-scale data collection was the use of case studies of selected State educational systems and schools.

It was found that approximately two-thirds of Australian secondary schools had adopted ASEP materials within two years of their publication. Large variations in levels of adoption occurred between schools. An important factor which was associated with variation in adoption was the State in which the school was located.

The analysis of State or system level effects was carried out through a comparative study of three States which were characterised by high, medium and low levels of adoption and use of ASEP in schools. Continuing high levels of adoption and use were associated with: teacher access to the ideas and materials of ASEP during the formative stages of the Project, the availability of curriculum guidelines sympathetic to the ASEP rationale, and encouragement for schools to change their curriculum by key agents such as curriculum consultants.

In the schools, the successful implementation of ASEP ideas and materials was related to the climate of innovation in the science department. The climate included measures of the departments' attitudes towards, and linkage to, new knowledge about science education. In addition it included measures of factors which encouraged the effective planning of science programs based on new knowledge.

On the basis of this study, it is argued that effective dissemination and implementation of innovations requires continuous system level support. In addition, it requires that the users possess certain attributes, including: attitudinal receptivity to change, cooperation between those involved in using the innovation in schools, and effective organisation of materials and facilities.

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CHAPTER ONE

PROLOGUE

Introduction

The past decade has been characterised in Australia by educational change and in particular by adjustments and modifications to school curricula. This study is concerned with an examination of factors which affect curriculum change. This is an important area of interest in this country since there has been an increased effort in recent years in national curriculum projects and at the same time considerable emphasis on promoting curriculum development at the local school level (Skilbeck, 1975).

The trend towards greater school responsibility for curriculum development in Australia in the 1970's is in marked contrast to the conditions in the United States of America, and to a lesser extent in the United Kingdom, in the 1950's and 1960's. In those countries large-scale curriculum developments were envisaged as the means by which the general quality of educational practice could be improved. The swing to an emphasis on school-based curriculum developments resulted after evidence (for example by Sarason, 1971; Fox, 1972; and Goodlad et al, 1974) suggested that large-scale curriculum projects were having little effect on teaching practice in schools.

Although a general consensus has developed in the educational community that curriculum freedom for schools would ultimately lead to a better education for students, there has been little study of the factors which facilitate curriculum development in schools. If it is the case, and it seems to be, that even greater responsibility for curriculum control will rest with schools in the future, it is necessary to identify the factors located within schools and those of support systems based outside the schools which are associated with the planning and execution of high quality courses.

The completion in 1974 of Australia's first national curriculum project, the Australian Science Education Project (ASEP), thus occurred at a time of uncertainty about the usefulness of large-scale curriculum developments. But the ASEP endeavour was not of the typical Research, Development and Diffusion (R, D and D) format in that the materials produced did not constitute a total course, but a set of units from which schools could choose some or all for incorporation into their programs. Whether they would, or would not, was not known, and it seemed to be important to determine the extent to which schools planning their own courses selected ASEP materials and adopted the ideas of the ASEP development.

The ASEP team carefully considered the essential components - aims, content, methods and evaluation - of a curriculum development. In addition, they employed findings about the cognitive development of children to set levels of difficulty for the ASEP units. Also, before text materials were written, there was extensive research into factors affecting the reading levels of students (Gardner, 1972). The materials were then packaged in a manner which differed from that employed hitherto for curriculum units. For each of the 47 units there were separate written texts for students and teachers. Texts for teachers included a guide to the intellectual levels of learning sequences, to the reading levels of the sequences, and other information designed to assist with beginning a unit in a classroom.

The developers also attempted to influence the content of existing science courses and the methods by which they were taught. The ASEP units emphasised the involvement of students in the classroom, not only in carrying out experiments, but also in planning what was to be done. A large proportion of the units were based on a cross-disciplinary approach to science rather than focussing on traditional subject areas: some units dealt with topics on sex education and anthropology. These topics were generally outside the spectrum of most science courses in Australian secondary schools at the time of ASEP's inception.

In view of these aspects and of the modifications in curriculum control in schools and school systems, the impact of ASEP was considered an important issue to form the basis for a study of curriculum change in Australia. An intriguing question was; what do teachers, compared with the ASEP developers, see as the important elements in a science curriculum? Associated questions were; what methods were used by teachers in planning their courses, and what use do they make of material and human resources? The answers to these queries were seen as important in providing data in the Australian context to help with the formulation of conclusions about the abilities of teachers to engage in rational planning in schools, to identify the curriculum resources which need to be made available to teachers from sources outside the schools and to identify, inter alia, school factors which ought to be changed in order that better courses are implemented.

The national effects of ASEP stimulated the enquiry reported here. Now ASEP remains a unique event in the history of education in this country in that it was the first curriculum project supported by the Federal and all six State Governments. To understand why this was so it is essential to review some developments in the administration of education in Australia up to and including the period when the materials from the Project became available. These developments occurred within a complex set of relationships between Federal and State Governments over time; relationships which have undergone modification during the past 15 years.

Commonwealth-State Relations and the Control of Education

The responsibility for the administration of education in Australia traditionally rests with six State Governments and, prior to 1963, no Federal monies were granted directly to schools. But in that year as a part of a pre-election promise (Menzies, 1963) funds were made available for science facilities in Government and non-Government schools. Subsequently the Federal Government provided additional monies for school libraries (1968) and later for some capital and recurrent costs incurred by schools (Ainley, 1976).

Now the entry of an Australian Government into a field previously regarded as a State concern was an example of an emerging national perspective on education, in contrast to one conceived narrowly in terms of local issues (Bassett, 1971). One writer has suggested that this change resulted from an increasing public interest in educational matters, an interest which was kindled through publicity given to visiting scholars and through the perspectives gained by Australian educators who went overseas to study and returned with new educational ideas (Keeves, 1967).

In 1969 the Federal Government moved into the field of curriculum development by providing funds to support the Australian Science Education

Project. This significant event also involved all State Governments in a financial commitment to the Project (ASEP, Newsletter 1, 1970). The Federal Government's contribution was just over $750,000. This was a moderate amount compared with the total Federal expenditure on science facilities to schools which amounted to $A123 million over 13 years (Ainley, 1976).

Over a period of five years from 1969 to 1974 the ASEP team, consisting of administrators, writers, evaluators, publishing and editing staff, produced 47 units designed primarily for use in science classes in secondary schools. Part of the contribution of the States was in the form of personnel, namely teachers of high repute. As will be shown in chapter Two, there was insufficient funding for Project activities over and above the primary function of the ASEP development, to provide learning materials for science courses. Any possibility of further funding or the retention of the ASEP team for work in other curriculum areas was eliminated by developments in the political arena in the early part of the 1970's.

When the Australian Labor Party became the Federal Government in late 1972 the Interim Schools Authority recommended the setting up of a national curriculum agency. Subsequently the Curriculum Development Centre (CDC) was established:

> to undertake curriculum development tasks and to develop teaching and learning materials for use in schools;
>
> to commission and support curriculum and materials development;
>
> to publish assessments and information about equipment and materials; and
>
> to provide advisory services relating to curriculum and materials development.
>
> (Australian Department of Education, Report on National Workshop, 1974:29.)

This thrust opened up a range of new issues relating to the production of curricula and moved attention to the teacher in the school, to his concept of what constitutes a curriculum, and to the identification of the external resources needed by school-based developers.

The trend to encourage local curriculum control was also being accepted at the State level. The details of these trends are outlined in chapter Two with respect to science programs in secondary schools. As a consequence of these developments there appeared to be little prospect that the ASEP ideas on materials would be prescribed to schools by State authorities. Nevertheless, it was still possible that agencies within the educational milieu at the State level could influence teachers in their decision to adopt or reject the products of the ASEP development.

Focus for the Study

To guide a study of the impact of the Australian Science Education Project in an environment characterised by increasing devolution of authority to schools the following research questions were fomulated:

(1) To what extent have the ASEP materials been adopted and used by Australian schools and how has this adoption and use varied over time?

(2) Has the extent of adoption and use of ASEP materials varied from State system to State system? If so, which systems were associated with high adoption and use of the materials in the schools? How does the use of ASEP materials relate to local characteristics such as existing syllabuses and locally developed materials?

(3) What are the characteristics of the user group, such as a science department within a school, which are associated with the incorporation of the ASEP ideas and materials into its science curriculum?

This study of the fate of ASEP has three major ramifications for educational theory and practice. First, it is an essential part of the summative evaluation of a unique curriculum development in the Australian context, an endeavour which has now been recognised by critics such as Batoff (1975) and Jenkins (1976) as a fine example of a large-scale curriculum development. Secondly, it yields understandings of the factors which affect the adoption of new curriculum ideas and materials by users. Thirdly, it provides information about the problems of implementing courses based on new knowledge and about the characteristics of users who were associated with successful implementation. In these last two respects the study of the impact of ASEP can be considered as a further contribution to a generalizable theory of educational change, a theory which at the present time is lacking (Heathers, 1974). Generalizable theories of change need to be developed in order to streamline the mechanisms by which curriculum change and curriculum development can be made more efficient and effective in educational institutions.

CHAPTER TWO

DEVELOPMENTS IN SCIENCE EDUCATION LEADING TO THE AUSTRALIAN SCIENCE EDUCATION PROJECT

The major purpose of this chapter is to provide an historical perspective to the ASEP development. This information is necessary to assist in the explanation of the subsequent reactions of administrators and teachers to the ASEP materials. In this chapter the initiation, activities and demise of the Project team are described. These features, however, cannot be fully understood without a brief reference to overseas sources which influenced the form of the ASEP development, namely the evolution of curriculum models underlying large-scale science projects in the United States of America (USA) and in the United Kingdom (UK).

Curriculum Developments in the USA and the UK

United States of America

In the period between 1956 and 1969, there were several curriculum developments in the USA and UK with which Australian educators were acquainted and which consequently influenced the nature of ASEP. In America the initial thrust to provide materials for the updating of senior school science courses came from scientists (Marsh, 1963). In the decade following the first project which was the Physical Science Study Committee (PSSC), the National Science Foundation contributed over $US100 million to support major curriculum projects in the sciences and mathematics (Evins, 1966). The early project developers had as a major aim the updating of content matter in science subjects taught at senior secondary school levels. Complete packages, including appropriate texts and apparatus, were provided for teachers to conduct their courses (Grobman, 1970).

By the early 1960's the work of curriculum development included the provision of courses for use in other areas of schooling. Educators and psychologists became involved with scientists and teachers and, consequently, new curricula took cognisance of learning theories, especially those of Piaget, Gagne and Ausubel. Projects which provided materials for use in elementary schools were founded on a common premise which stressed that science was an integral part of the education of all students, that science should be taught as an integrated subject, and that the teaching of science should incorporate the spirit of discovery. But perhaps what was just as significant for the subsequent work of the ASEP team were the differences in the form of packaging of these projects. Whereas Science a Process Approach (SAPA) and the Science Curriculum Improvement Study (SCIS) provided extensively arranged curriculum materials based on models of hierarchical learning (Gagne, 1966), another major elementary science course, Elementary Science Study (ESS) was relatively unstructured. Fifty-six units were produced by ESS which were suitable for students in various year levels and most could be used independently of the others.

The lack of flexibility of SAPA and SCIS created problems in management when schools decided to adopt them:

> In the projects (SCIS, SAPA) there is a more sequential placement of lessons or units in an hierarchical order. This, however, works against adoption because the whole

> school or district must adopt the program and phase it in from the lower to the higher grades. This need for a phase-in requires both teacher and administrative commitment to the program, and further requires that consensus be reached in the school before the program is tried out. Upper grade teachers are then expected to wait several years before they are allowed to participate.
> (Butzow, 1973: 20-22.)

In general most project developers had not fully considered the practical problems associated with the introduction of project materials into schools. The ESS project was among the first to develop units of work and the result was greater flexibility for users. This "unit" characteristic was also incorporated into the Harvard University 'Project Physics' course, begun in 1964. Rather than produce a single textbook the developers compiled a set of units and some ancillary topics were presented in the form of student readers.

A further step towards greater flexibility was taken in the Intermediate Science Curriculum Study (ISCS). In this project there was scope for groups of students within classes to work on a variety of activities. This appeared to be an important development for ASEP as ISCS was a course for junior secondary school pupils and it offered the chance for students to work at different rates. The ASEP team was aware of this development, for one of its Assistant Directors wrote:

> As a reaction to earlier projects which had, at the most, encouraged small group or individual activity within the class framework so that the teacher could tie together at the end what had been learned in a class discussion, ISCS introduced self instructional, self pacing materials complete with tests for self administration. All procedural instructions were part of the student material so that the teacher was freed from giving directives and students could work at their own pace. The materials provided an essential core which covered the main ideas and a series of 'excursion' activities designed to extend the more able or provide remedial activities for the less able.
> (Ramsey, 1972: 23.)

At the same time newer 'second generation' projects allowed greater teacher participation in the trials with the materials and included more extensive inservice teacher education than before. This was apparent in the BSCS Life Science project which broke new ground in that a teacher education component was built in as part of the overall project design (Clark, 1969). But despite these changes there was evidence that these curricula were not having a major impact on teaching practices or in improving student achievement (see, for example, Ramsey, 1970a; Sarason, 1971). This evidence raised fundamental questions about the most efficient ways of effecting change in school systems.

Research efforts have turned away from the study of the effects of innovations on student learning to the problems of adoption and implementation of innovations in schools (Fullan, 1972). This has affected traditional evaluation techniques which had previously concentrated on student gains as a measure of the success of a project and led to a consideration of the extent of implementation and its relation to achievement. These new considerations have influenced the format of this study, and will be taken up again in chapter Three.

The United Kingdom

The thrust for development of science curriculum projects in the United Kingdom came, not from the concern of university scientists as was the case in the United States of America, but from the interests of science teachers. They worked through their professional organisation the Association for Science Education which cooperated, not with government, but with the Nuffield Foundation, a private charitable fund (Waring, 1975). The pattern of development which commenced in the early 1960's was similar to that in the USA in that early projects were concerned with science disciplines and little attention was given to learning theories (Fensham, 1971). Later courses such as Nuffield Combined Science attempted an integration of subject matter. The establishment of Science 5/13 and Schools Council Integrated Science Project (SCISP) showed an increased awareness among English teachers and administrators of the underlying theoretical concepts of cognitive development in children. Science 5/13 for example, based the production of its materials on Piagetian stages. The SCISP materials ('Patterns') were developed after the project officers had constructed aims in both the cognitive and affective areas of knowledge (Hall, 1971). As in America the evidence regarding the impact of these courses suggested that the materials and ideas of the projects were often not implemented in practice (Wastnedge, 1971).

Thus by the end of the 1960's, there had been modifications in the structure of curriculum projects designed to improve teaching and learning in the sciences. Australian educators considering improvements in science courses in this country were in a position to compare the evolution of curriculum development in two countries with cultural and economic characteristics similar to their own, and to gauge the effects of the various project designs.

Science Curricula in Australia Prior to 1969

In the previous section advances which were made in science curriculum project designs in the USA and the UK were outlined. Their impact in Australia must be seen in the light of the way Australian systems of education have approached the administration of the curriculum. This brief historical description is designed to show that science evolved

31

as a subject in all State systems before the advent of ASEP, and that there were important developments in science education in Australia which preceded ASEP and paved the way for its initiation.

Since federation, the administration of formal education has been the responsibility of respective State Governments (Board, 1935). Before 1940 each State operated two public examinations which served to delimit two major stages of secondary schooling. These examinations were the Junior or Intermediate and, at a higher level, the Leaving or Senior. English, mathematics and foreign languages were taken by the majority of candidates in each State at the Junior level but the sciences were not widely studied. Where the sciences were taught, the English model of a study of separate science disciplines was followed. Table 2.1 shows the popularity of these subjects in 1932.

Table 2.1 Percentages of Students Studying the Sciences in the Junior Public Examinations 1932. By State. (After Seitz, 1935)

	NSW (N = 11995)	VIC (8000)	QLD (2396)	SA (2969)	WA (1703)	TAS (590)
Botany	15	14	-	18	-	-
Chemistry	10	19	32	32	15	43
Geology	-	-	-	20	-	-
Physics	-	27	32	41	39	25
Physiology	-	-	14	-	-	-
Biology	-	-	-	-	31	-
Elementary Science	48	10	-	-	-	-

Note: NSW - New South Wales; VIC - Victoria; QLD - Queensland;

SA - South Australia; WA - Western Australia; TAS - Tasmania

In general, physics and chemistry were the most popular subjects; the biological or earth sciences were rarely taught. Variations in the popularity of chemistry and physics from State to State were notable and possibly reflect the influence of parochial interests, although no data to support this contention are available. In two States, New South Wales (NSW) and Victoria (VIC), there was an emergence of an integrated science course in the 1930's. In NSW this subject was included in seven of the nine alternative school curriculum plans available to students in government schools. Students in registered non-government schools tended to study the separate sciences (Seitz, 1935).

However after the Second World War three factors affected the teaching and presentation of science in the secondary school. First, a greater proportion of the possible number of students entered the secondary school. Second, there was an increase in the emphasis on the sciences in the total curriculum. Third, the General Science movement, initiated in Britain in 1936 began to affect the form of science syllabuses in Australian States. This took place as a result of the influence of visiting educators such as Ashby (1946). There was a general move toward General Science as:

> a course of scientific study and investigation which has its roots in the common experience of children and does not exclude any of the fundamental sciences. It seeks to elucidate the general principles observable in nature without emphasising the division into specialised subjects until such time as this is warranted by the increasing complexity of the field of investigation, by the developing unity of the separate parts of that field and by the intellectual progress of the pupils.
>
> (Science Masters' Association (SMA), General Science Sub-Committee 1936:30)

From the mid-1940's Australian science syllabuses had begun to change. General Science courses replaced the separate science subjects in Tasmania and Victoria in 1945 (Waddington, Radford and Keats, 1950) and by 1961 South and Western Australia had followed suit (Stanhope, 1961). By 1966 all States offered a subject called 'General Science' (Power, 1966). However the manner in which the science in General Science of this period was integrated varied between States. In South Australia integration was achieved by basing the course on a unified process of scientific enquiry (South Australia, Manual of Syllabuses, 1966). In New South Wales integration was attained by basing the courses around the theme of energy (New South Wales, Syllabus in Science for Forms I-IV, 1963). A thematic approach involving over 20 topics was followed in Western Australia (Western Australia, Science A and Science B for Secondary Schools, 1962). Tasmania and Queensland listed their integrated courses under traditional subheadings of astronomy, biology, chemistry, geology and physics (Tasmania, the Schools Board of Tasmania, Manual for 1966: Queensland, Science A and B, 1967). In all States attempts were made to cater for a range of abilities and interests of students by offering alternative forms of study, generally after a common program in the first year.

Developments in Victoria were somewhat similar. An early attempt was made to base a science course on scientific enquiry in technical schools in 1962. Power summarised its characteristics:

> The course has been built around a number of principles derived from the scientific process or characteristic ways in which scientists behave. Associated with each principle is a variety of activities drawn from several sciences. Thus the principle 'Scientists must make accurate observations' is followed by a series of activities designed to develop the student's power of observation. The 'black-box' situation is used to promote an understanding of the work of the scientist in the formulation of theories and hypotheses.
>
> (Power, 1966: 31.)

Then, in 1966, due to the interest of a number of organisations, including the Science Teachers' Association of Victoria (STAV) and the Australian Council for Educational Research (ACER), the Victorian Universities and Schools Examination Board (VUSEB) instigated discussions which led to the commencement of the Junior Secondary Science Project (JSSP). The aim of the Project was to encourage an individual approach, based on a class set of cards, booklets and associated materials, rather than rely on a single textbook as a resource. The materials were designed to provide:

> (1) laboratory and field experience as an integral part of the learning experience;
>
> (2) opportunity for each student to proceed at his/her own rate;
>
> (3) a basic learning sequence for all students;
>
> (4) additional enrichment material both within the basic sequence and in the form of optional extras;
>
> (5) remedial activities where understanding had been incomplete;
>
> (6) frequent testing of progress and redirection where desirable;
>
> (7) flexibility in structure to facilitate revision, supplementation or substitution of relevant materials.
>
> (Dale, 1966: 44.)

JSSP was set up to provide updated materials for science in Years 7-10, the first four years of secondary school.[1] Production of units was based on a set of objectives 'consistent with modern thinking in science education and with a knowledge of the learning process involved' (Dale, 1966: 43). The materials were produced by a small team operating at ACER. The Project undertook inservice education and units were trialled in a number of schools.[2] A unique feature of the organisation of the Project was the continuous involvement of students in the process of learning through the use of apparatus and worksheets.

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[1] Throughout this thesis, grade levels will be referred to using the recent convention adopted by the Australian Education Council. Thus in States where there are six years of secondary schooling (NSW, Vic and Tas), levels are referred to as Years 7-12. In States where there are five years of secondary schooling (Qld, SA and WA), levels are referred to as Years 8-12.

Between 1966 and 1969 18 units, suitable for use in the first two years of the secondary school, were published. It was planned to produce units for all levels of the junior secondary school, but the shortage of financial resources (less than $100,000 was available) caused the Project team to modify its original proposals.

The development of JSSP materials occurred at a time of change in control of the curriculum in Victorian secondary schools. For example, the Intermediate Certificate (Year Ten) was discontinued in 1967 and this gave schools the freedom to vary the courses of study offered in the first four years of secondary schooling. A central authority, the VUSEB, replaced the prescriptive science syllabus by suggestions for courses of study in an attempt to provide guidance but not direction to schools.

Its advisory document was a more sophisticated statement of a curriculum in science than the one it replaced. Up to 1967, the major emphasis was on the content to be covered which was organised around five conceptual themes: the Earth in Space, the Earth Itself and Its History, the Properties and Structure of Matter, the Behaviour of Matter, and the Concept of Energy and Living Things (Victoria, VUSEB, 1966). The new guidelines contained a list of aims and included suggestions for their evaluation. Among the aims of the course were that students should acquire: knowledge of scientific facts and principles, scientific skills, and an appreciation of the scientific method. The designers were of the opinion that:

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[2] Junior Secondary Science Project - A Progress Report. ASTA Journal, Vol. 37, No. 71, May, 1967.

> The new course is designed to give a wide and adequate background to the world of science and a reasonable understanding of what science is. It is to be regarded as the minimum training for every educated citizen.
>
> (VUSEB, 1968: 188)

A more detailed statement of aims was included in the next major revision of the science syllabus, which occurred in 1971. By this time, the JSSP materials were being used in schools, and an outline of their characteristics was included in the advisory syllabus.

One new and significant feature of curriculum development in Australia was associated with the production of JSSP materials; they were trialled and used in schools in more than one State (Trapnall, 1969). Prior to this the provision of curriculum materials, textbooks, and other aids had occurred in each State without official consideration of what had been produced in other States, even though there were often similarities in the content material covered (Ramsey, 1972). JSSP units were trialled in schools in South Australia, Tasmania and Victoria and these materials were subsequently adopted in their final form by schools in the latter two States (White, 1976). That several State educational systems had cooperated in such a Project was an important precursor for a national effort, along the lines of those which had beon mounted in the USA and in the UK.

The Australian Science Education Project

Establishment

In the period prior to and during the development of the JSSP materials a belief existed among Australian science educators that curriculum materials produced at a national level might prove an efficient means of upgrading the quality of science teaching in Australian secondary schools. These views often surfaced at the annual conference of the Australian Science Teachers' Association (ASTA), at which teachers from all Stages gathered to debate current trends in the teaching of the sciences. In 1964, the Council of the ASTA stated that:

> the Australian Science Teachers' Association foresees that improvements in science education will result from a variety of activities within each State and Territory, but it also foresees that certain major improvements can come about only through coordination of efforts at national level.
>
> (ASTA Council Statement, 1964: 42.)

Then, at the 1965 Annual Meeting of the Association, two distinguished speakers supported the notion of national curriculum projects. One identified a trend toward national level thinking in education and argued on a number of grounds that such an approach should be encouraged (Bassett, 1965). The other, who was influenced strongly by recent contacts with American science curriculum projects, reviewed the state of science teaching in Australia. When commenting on unsatisfactory features in textbooks and syllabuses he advocated a project approach to curriculum development.

> .... I am decidedly of the position that greater benefit would accrue to science teaching in any State or the Commonwealth if some of the funds now being devoted wholly to the provision of material facilities was diverted to financing a scientific approach to science curriculum construction.
>
> (Stanhope, 1965: 221.)

In 1966 the establishment of the Commonwealth Department of Education and Science by the Liberal Party created greater potential for the Federal Government to participate in State educational matters. In 1967, the then Senator John Gorton, the first Minister of the new department, enunciated two important notions at a State science teachers' conference. These were: first, that the idea of a national curriculum development should be entertained, and second that through such a development, methods of teaching could be influenced.

> I don't think we have the manpower, the capacity to do six content revisions, six such studies of courses in various disciplines and the ways of teaching them. It would surely be better for us, as has happened in the case of 'The Web of Life' for the talents of science teachers, notes, manuals, methods of approach which would not be mandatory to be adopted throughout Australia, but which would be the product of a group of the best people in that discipline that this nation can produce. It could be adopted in whole or in part according to the decision of the Science Teachers' Associations in different States, and according to the individual judgement of the teacher; because one of the major objects of these courses, as I have said, is to move away from approaches to science which involve teachers standing up and talking and pupils listening, to approaches to science where the student is participating, is experimenting, is guided by the teacher; and not merely regarded as something on which the teacher can practice his mentor's skill.
>
> (Gorton, 1967: 11.)

The Minister's remarks implied that an approach to the Federal Government for support for projects involving more than one State would be welcomed by his department. This invitation was subsequently taken up by ACER, which acted as an initiating and coordinating body for the proposal. In July 1967 the Director (Dr. W.C. Radford) sought reaction from State Ministers of Education in Tasmania and South Australia and other persons to a proposal that these two States combine with Victoria to expand the Junior Secondary Science Project. This proposal involved a joint submission to the Federal Government for assistance. Both States expressed an interest but did not immediately commit themselves.

The first formal approach to the Federal Government was made in September 1967 by a representative of one of the States involved. The Deputy Chairman of the Science Standing Committee of the VUSEB (Mr. R.H. Wilkinson) wrote to Senator Gorton asking for Federal support for a project if it could be guaranteed that the three States would cooperate. A favourable reply was received and, following a meeting arranged by Radford in Melbourne on 13-17 November 1967, a proposal endorsed by education authorities in the three States was completed and forwarded to the Ministry of Education and Science in March 1968 (ACER File PRO/29, Correspondence, 1968). In essence the proposal, which was drawn up at ACER, requested that the Federal Government:

> provide the sum of $1,200,000 (approx.) over the period 1968-1972 inclusive for the development of a syllabus, courses of study and the necessary materials in science for Grades 7 to 10 inclusive in schools in South Australia, Tasmania and Victoria.
>
> (ACER File PRO/29, Draft Proposal, 1968.)

Clearly the provision of materials was one of the major objectives of the project. However, it was also acknowledged that a skilled group of curriculum developers could be formed to continue with curriculum activity on the conclusion of the cooperative project in 1972. The proposal stated that:

> ... near the end of (1971), a careful assessment of the effects of the expanded (JSSP) project could and should be made by an independent agency, and decisions reached about both the desirability and the nature of any subsequent activity of the extended JSSP or any project arising from it.

Also,

> There are many alternatives available after 1971, for example:

> (1) A substantially reduced project, financed by royalties, could maintain regular revision and further supplementation of JSSP materials.
>
> (2) A new and different approach to junior secondary science education could be applied to another project or a reorganised JSSP.
>
> (3) The project's staff and organisation could be regarded as a means of initiating a National Curriculum Centre (or Institute) to undertake curriculum development in science or, more widely, in many school subjects.
>
> (ACER File PRO/29, Actual Proposals, 1968:9-10.)

After a short delay, the Federal Government agreed to provide support and in November 1968 at a meeting in Melbourne the participating parties discussed the responsibilities of the four governments involved. It was decided that an appropriate method of control was through:

> the establishment of a management body to be called the JSSP Committee of Management (COM). This body would comprise one representative of each of the three State Ministers, and of the Federal Minister and of ACER, with the Project Director as executive officer.
>
> (ACER File PRO/29, 1968.)

During the early stages of negotiation, the three States not involved had been kept informed and at the March 1969 conference of the Australian Education Council, the annual meeting of all Directors' General and Ministers of Education, the Federal Minister for Education and Science suggested that New South Wales, Queensland and Western Australia might also wish to collaborate in the project. By September 1969 all States had agreed to participate and at the second meeting of the COM in November, the development became known as the Australian Science Education Project (ASEP).

Planning

The original proposal had, as a budget, the sum of $1,200,000 with the Federal Government contributing $750,000. This funding level was maintained even after the three additional States were included. The yearly contributions of each of the States, which were in proportion to population of their schools, were as follows:

New South Wales	$34,320
Victoria	$24,840
Queensland	$13,200
South Australia	$8,040
Western Australia	$6,480
Tasmania	$3,120

(Australian Science Education Project (ASEP), COM Minutes, 26 September 1969: 10.)

There was provision for the States to contribute through cash payments or to provide staff as an alternative form of support. One of the first tasks of the COM was to employ senior staff. A Director (Mr. H.O. Howard) and two Assistant Directors, Mr. L.G. Dale (Development), and Dr. G.A. Ramsey (Services) were appointed by 1 October 1969, and other senior positions were confirmed later. The appointees to the executive positions had a marked effect on the nature of the project, especially its underlying philosophy. Dale, originally a Victorian science teacher, had been responsible for the production of the JSSP materials which were so different in structure from the science texts used in most Australian schools. He influenced the format of the ASEP materials and the use of Piagetian stages as a basis for their organisation. Ramsey, originally a South Australian science teacher, was recruited directly from Education Resources Information Centre (ERIC) in Ohio, USA, where he had examined the effects of the CHEM Study project on teachers (Ramsey, 1970a). The period he spent in the USA was valuable for gaining a first-hand knowledge of the various American curriculum developments (Ramsey, 1975). This experience too affected the form of the ASEP materials and also the plans for the project. In particular, Ramsey was aware of the needs of effective dissemination tactics to be employed in the project. During the planning stages he stated:

> There is no worse experience for a teacher than to have thrust upon him materials which he did not request, and which he is not trained to use. This has happened before, and the results have been disastrous. It need not happen with ASEP if adequate planning and funds are available to carry on this task when the present project (ASEP) is terminated.
>
> (Ramsey, 1970b.)

When the COM met in November 1969 the three project executives prepared the following statement. The purposes of ASEP, they said, were:

> (1) to develop instructional materials in science for use by teachers and pupils in Grades 7-10 in Australian schools;
>
> (2) to carry out such evaluation of current practices in a cross-section of Australian schools as is necessary to ensure that Project materials are tried in a variety of situations where the characteristics of the school, teachers, and students, have been adequately described;
>
> (3) to produce suitable evaluative and descriptive instruments designed for use with Project materials;
>
> (4) to develop a model of a teacher education program for the implementation of Project materials in schools, and implement it in conjunction with teacher education authorities throughout Australia; and
>
> (5) to establish a specialist resource service for the developers of Project materials, for trial teachers in schools, and for other teachers interested in Project materials but who may not be using them in the trial situation.
>
> (ASEP, COM Minutes, 21 November, 1969: 7.)

The COM, however, decided that:

> the outstanding priority is accorded by all States to Purpose No. 1, the other four purposes to be fulfilled only in relation to the materials that are being developed. (ASEP, COM Minutes, 21 November, 1969: 7.)

This decision implied that most of the responsibility for training teachers to use ASEP materials would rest with State authorities. To assist with liaison State Advisory Committees were set up, composed of representatives of schools, universities and teachers' colleges. Generally the Chairman of the State Advisory Committee represented the State on the COM. In many respects this person was a key individual in the ASEP organisation. He was the link between the work of the Project and the science teachers and other educators in his State. In addition, by virtue of his position, he was able to influence decision making with respect to the Project.

To initiate activity of the ASEP development, a 'guidelines conference' was held in early 1970, attended by academics from many disciplines, representatives of schools, and those involved directly in the project. Several themes were developed, one of which was not covered by the Project's brief. This was the need to re-educate teachers of science in order for the materials to be successfully implemented (Fensham, 1970; Ramsey, 1970b; Rechter, 1970).

As materials were developed after the guidelines conference two main ideas emerged. The first, a theme emphasising the place of the child in his environment, was chosen as a basis for selecting the content matter being developed. The second, the nature of science and its relationship to technology, was an influential feature in determining the organisation of materials within units (ASEP, A Guide to ASEP, 1974: 91-94).

Some features from American curriculum projects were adopted by the ASEP team. For example the construction of units of work presented in separate booklets was similar in format to the BSCS Life Sciences project. The ASEP units contained a core of material which all students would follow plus a number of electives from which they could select and this mirrored aspects of ISCS. The advantage of units over a textbook, first introduced by the Project Physics developers, was to give flexibility to teachers to select from among the ASEP offerings (Moritz, 1975)

Another important feature of ASEP, one which also occurred in curriculum projects in the USA, was the attempt at large-scale formative evaluation during the production of the textual materials. Essentially this was attempted through 'trials'. As units were produced one 'Local Trial' was arranged with cooperating teachers and then, after feedback and modification to the unit, a 'National Trial' was held with assistance from teachers in all States. Through these trials teachers became acquainted with the characteristics of the materials. The trials were a means by which the ASEP developers attempted to influence the subsequent adoption of ASEP ideas and materials by potential users (Ramsey, 1975).

As already indicated, two notable features of the ASEP development were the attention given to reading difficulty and to the intellectual levels of the materials. Attention to reading was a consequence of the findings in the JSSP evaluation that many students found it difficult to comprehend passages contained in JSSP units (Dale, 1976). The basis for setting the intellectual levels for material in the units was based on Piagetian stages and reflected the burgeoning interest of science educators in Australia, the UK, the USA and elsewhere in his work.

A measure of the quality of the ASEP endeavour can be made by comparing its characteristics with the views of science educators regarding the nature of curriculum development in science needed for the 1970's. At a conference hosted by the National Science Foundation in the USA it was agreed by the participants that new science courses should be characterised by:

(1) interesting and useful work for all students;
(2) specification of a minimum level of scientific literacy and capability for high school graduates;
(3) flexibility of choice of instructional goals beyond the minimum ones;
(4) units of work considerably shorter than year length courses;
(5) a balance of basic and applied interests including not only chemistry, physics and biology but also with other sciences including the social sciences;
(6) program units as independent as possible;
(7) a variety of ways of student working;
(8) systems for students to work at different rates;
(9) low cost; and
(10) assistance for teachers in choosing and implementing a new program.

(Burkman, 1972: 42-44.)

ASEP's framework for developing learning materials took account of most of these characteristics. That the ASEP framework was developed in 1969, three years before the National Science Foundation Conference report was published, indicates that ASEP was in the vanguard of curriculum construction in the sciences.

Development

Writing and trialling of units began in May 1970. Work was according to a strict schedule which involved not only writers and others at the central development office in Melbourne, but also working parties in all

States. Rising costs affected the Project throughout, particularly the extent of trialling. Problems associated with cost increases reached a maximum in late 1972 when, in response to a plea to the six governments involved, a further $200,000 was granted to the Project to enable it to complete its term. By February 1973 the Director was able to report to the COM that 47 units, including one designed for use in teacher education, were in various stages of production, and of these 31 had been substantially completed (ASEP, COM Minutes, ASEP Progress Report, August 1973: 2). By March 1974 when the Project concluded, all 47 units had been completed and throughout that year they were made available to schools.

Termination

Despite strong pleadings, both from the Project team and from others, that some staff members of ASEP should form a unit to cater for the continuing needs of science teachers, or on a larger scale, to form the nucleus of a national curriculum group, this did not eventuate. However, as part of the newly formed Curriculum Development Centre (CDC), two ex-ASEP staff members were employed for a time to give some assistance to schools after March 1974. By 1976 there was no-one in the CDC's employ who had taken part in the original ASEP development.

Recapitulation

The Australian Science Education Project marked a new national phase of curriculum development in Australia; all States cooperated in the development to provide science learning materials. This occurred through the combined efforts of personnel drawn together from New Zealand and all Australian States. Several were secondees from State Education Departments who, after their involvement in the Project, returned to their own States.

The Project began at a propitious time in that senior ASEP staff were able to assess the strengths and weaknesses of large-scale science curriculum developments in the USA and the UK before undertaking planning. The result was the production of learning materials which were sophisticated in design and incorporated new approaches to the study of science in a course of general education.

The ASEP model of curriculum development also acknowledged that the approaches it encouraged were different to current practice and included plans for comprehensive reeducation of teachers to use its products. But this last phase was never implemented. This meant that control of an important facet of the endeavour was not in the hands of the developers. Agents in each State were responsible for this aspect of the Project.

As a consequence there was a distinct possibility that ASEP materials would be adopted and implemented in different forms and amounts in different States. This situation meant that comparisons could be made of the impact of an innovation in curriculum in different contextual settings.

CHAPTER THREE

REVIEW OF RELATED RESEARCH

This study was designed to provide information about the ways by which ideas and materials associated with a large-scale curriculum project spread through the secondary schools of a nation, about the decisions and actions of State and local authorities to enable teachers to use the materials, and about school features associated with the successful implementation of the materials within science courses. As other researchers have examined some of these aspects it was necessary first to review their findings, to gather together their conclusions in order to create a basis for data collection for the present investigation. The studies reviewed represent diverse interests and to assist in synthesising their findings it was deemed necessary to relate them to different stages in the process of educational change, and to the different groups which take part in innovation. In the next section the different groups and their association with innovation are discussed.

Key Elements in the Study

Whenever an educational innovation occurs the ideas underlying it generally stem from some resource, individual, or group, and are conveyed in some way to those likely to put it into practice. In some cases the user and resource may be identical. In the general case there are three basic elements: the resource, the user, and the idea or message about the innovation. That the message must be conveyed implies that there is a fourth element, the medium, which represents that set of factors governing the transmission of information and the flow of the materials from the resource group.

Figure 3.1 shows these elements in simple relationship. This paradigm served to delineate the areas of research which were the focus for this study.

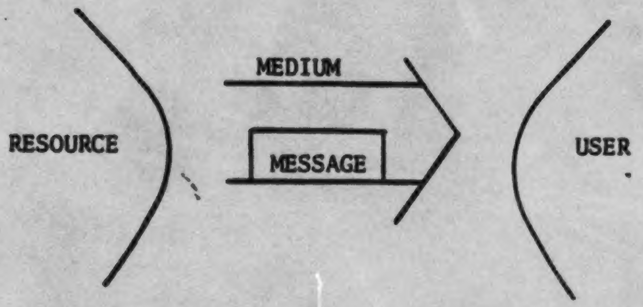

Figure 3.1 Basic Elements in the Innovation Process
(After Havelock, 1973a 1-10)

The research questions outlined in chapter One directed attention in the review of other studies towards an examination of the medium and the users, in order to determine those characteristics of each element which were associated with successful use of an innovation. With respect to the medium it was considered relevant to discover the ways in which knowledge about other innovations had been transmitted to users, and also to consider which factors contributed to the maintenance of innovations once they had been accepted. With respect to the users it was deemed valuable to examine reports so that a synthesis of user characteristics which were associated with the acceptance and implementation of innovative materials could be made.

A Review of the Role of the Medium in Innovation

A major aim of the present study was to compare the extent to which components within the educational medium of each State affected the adoption of an innovation and its implementation in schools. The review of literature was carried out in order to collate the findings from other studies which had examined these aspects of educational change.

The role of the educational medium in influencing change has been notable in the cases of large-scale curriculum projects which attempted to influence school curricula. This can be accounted for by the way in which resource groups initiating large-scale projects have been established. Miles (1964) described such resource groups as 'temporary systems' which were directed to provide a stimulus to educational practice. However, these temporary systems were often forced to rely on more enduring agencies for transmitting information to potential users both during the period in which a project was formulated and, later, when the temporary system had disbanded. In many instances little thought was given to the provision of support to adopting schools over and above that already available (CERI, 1973).

A review of the literature revealed that there were few studies devoted to comparing the roles of educational mediums. Writers have commented on this lack of available data (Harding et al, 1976). Of those research reports consulted a majority were concerned with a 'between user analysis'; that is, they were devoted to a study of user perceptions of medium support within a single educational system. Nevertheless, the findings from these studies were still useful for determining the mechanisms by which innovations in education have been supported by system effects. The studies are reviewed below.

Research into strategies in the medium associated with the use of innovations has taken place in the USA since the 1920's. Much of this research occurred in disciplines other than education, but many of the conceptualisations which have resulted have relevance to the study of educational change. For example, the studies have provided criteria by which the effectiveness of system factors in promoting innovation can be judged. One such criterion is that of adoption, which is generally considered to mean that the user has decided to accept or reject the innovation. A second criterion is implementation. This criterion is concerned with the translation of the ideas of the innovation into practice.

The use of adoption as a criterion implies that attention is focussed on the influence of system level factors which are present prior to the decision to adopt. That is, adoption results from the exposure of users to the characteristics of an innovation (Rogers and Shoemaker, 1971). Consideration of implementation as a criterion implies that attention is focussed on system level factors which serve to maintain the innovation once it has been adopted. However it is conceivable that implementation also depends on the ways in which the adoption decision was made. Factors such as the timing of the decision, the personnel involved, and potential users' knowledge of the innovation seem a priori to be of importance in studying the subsequent use of the innovation. Thus it was considered to be appropriate when reviewing research on medium effects to examine those studies which used adoption or implementation as a criterion.

Adoption as the Criterion

Adoption of an innovation has been widely employed as the criterion for the study of change in social systems. The emphasis on adoption, rather than implementation, has been influenced by the nature of many innovations and the characteristics of the users for which they were intended. For example, one thrust in agricultural innovation has been to persuade farmers to accept a new grain seed or fertilizer. Once this has been achieved the result of the acceptance is assured without assistance from medium level agents. This is not necessarily the case for educational innovations where the intended benefits depend greatly on the extent to which the characteristics of the innovation are implemented by teachers. In some cases benefits may also depend on adaptation of the innovation to meet local needs.

Studies which examine the effects of educational mediums are rare. A recent review of factors which affect educational change stated that:

> a ... shortcoming of the educational tradition ... is that researchers have largely ignored (1) consideration of communication channels, and (2) how the social structure acts to impede or facilitate diffusion.
>
> (Rogers and Shoemaker, 1971: 61)

Many early studies of adoption of innovation in schools were conducted in the USA at Teachers' College, Columbia, under the direction of the late Paul Mort. The unit of analysis was generally the school district or the school and data were generally obtained from school superintendents or principals by questionnaire. Rate of adoption by schools or school districts was linked to medium effects. Mort (1964) deduced that the extent to which innovations in education were accepted was slow compared with those in agriculture or medicine. It was suggested that these differences were due to:

(1) the absence of a scientific source of innovation in education, that is a centralised authority which

was able to invent, disseminate and evaluate the effects of innovations in schools;

(2) the lack of field workers whose task it was to promote new ideas in schools and school systems; and

(3) the shortage of finance for schools combined with the lack of economic incentives for schools to change their teaching strategies.

A comparison of the early work of Mort with more recent studies has shown that educational innovations tend to be adopted more rapidly now than in earlier times. Whereas, in the USA, the widespread adoption of kindergartens took over 40 years (Mort, 1953), driver education in secondary schools was accepted within 18 years of its first adoption in 1930 (Allen, 1956). More recently Carlson (1965) has shown that new approaches to mathematics teaching had been accepted in a majority of American schools within five years of their first availability. Rogers and Shoemaker (1971) attribute this trend to a general increase in support for change in schools by government and private agencies and to a more receptive attitude within the population to educational change. This has resulted in an increase in the availability of funds for advocates of innovation within schools.

Other recent research supports the contention that educational innovations tend to be adopted where the medium in which the schools are situated is generally supportive of change. Two American studies using contrasting evaluative techniques illustrate this. Both were concerned with the general level of innovativeness across the school. Corwin (1975) used questionnaires to gauge school innovativeness by composing a combined score based on the number of innovations adopted, and the extent to which they were used by teachers within a school. Thirty-three independent variables were used to explain the innovativeness of schools. Regression analyses were employed in an attempt to partition the source of variance between factors within and external to the school. In addition to identifying school factors Corwin (1975) stated that the highly innovative schools were likely to have:

> ... more support for change from the local community and active partnership between the school and community ...
>
> ... resources for change from outside the school and possibly from outside the community as well ...
>
> ... a community that is large enough to offer a variety of sources and pressure and support for change.
>
> (Corwin, 1975: 31)

Anthropological rather than statistical techniques were used by Hensel et al (1974) to examine aspects of educational change in 16 schools. After data collection, analysis enabled comparisons to be made within and between schools in order to arrive at a set of hypotheses which accounted for the introduction, maintenance, or discontinuance of the innovations. One 'conclusion' from these procedures was that innovation adoption was due to a combination of system or medium level effects and school factors. Encouragement and material resources provided by the system were necessary but not sufficient conditions for schools to become high adopters of innovation.

Studies of the type reported above show that medium or system effects influence the adoption of innovations but the findings are of dubious value. It is difficult for educational policy to be influenced by such conclusions which contain a high level of generalisation and uncertainty. It seems that research must find methods by which users can be assisted to use new knowledge and materials, and must identify how personnel who work at the system level can encourage sound educational practice in schools.

In this respect researchers in the United Kingdom have attempted to identify strategies which are associated with high adoption of science teaching innovations. Jenkins (1967) obtained data from teachers of biology and chemistry at an inservice training course in order to evaluate the extent to which Nuffield Foundation teaching materials had been accepted by schools. One of his findings was that teachers obtained information about the courses by contacting other teachers. Also it was found that important sources of course information were the publications of the Association for Science Education (ASE).

Two other studies, by Nicodemus (1973) and Kelly and Nicodemus (1973), considered the ways in which teachers obtained data about new science courses. Their results were similar to those of Jenkins (1967). It was reported that person to person contacts between teachers and publications of the ASE were major sources of information.

In a subsequent publication Nicodemus (1977) reported on a study he began in 1973. A sample of 433 teachers in 17 Local Education Authorities (LEA's) in the UK provided data on the major sources of information about materials of science education curriculum projects. These sources were, in order:

(1) science teachers from the same school;
(2) publications of the ASE;
(3) catalogues from scientific supply companies;
(4) science journals and magazines.

Although there was a wide representation of teachers in the sample, any extrapolation of results to the population of science teachers must be made cautiously since the response rate in the study was only 51 percent.

Teachers who responded were allocated to one of three categories; high, medium, or low adopters on the basis of their total use of the curriculum project materials. The system level factors which differentiated most between these groups as sources of information were, in order:

(1) publications of the ASE;

(2) memoranda and circulars from the Department of Education and Science;

(3) other schools council publications;

(4) circulars from curriculum development projects.

Clearly, information obtained by adopters about innovatory projects in the UK came most often from personal contacts with users or from written information from a variety of sources. These results, and those from other studies, reveal the relatively unimportant role of inspectors of schools and consultants in spreading information about an innovation in the UK. This feature can be explained by considering the limited roles these officers have in the English educational system. It has been established that teachers in English schools have a high degree of autonomy in deciding the structure of their courses (Taylor, 1970).

In the USA research by Yegge et al (1971), which examined the fate of the Project Physics materials, showed that journal articles written in local rather than national publications were an important source of information for teachers during adoption and implementation. In other

American innovations research, however, there is an emphasis on the roles of personalities in the promotion of new ideas and materials. These findings are now considered.

A well known study of educational change was that of the adoption of 'modern mathematics' in 107 school districts in the American States of Pennsylvania and West Virginia (Carlson, 1965). This research is important, not only because the unit of analysis was the school district, but because it employed a new approach to the collection of data. Interviews rather than questionnaires were used to identify the ways by which schools were influenced to adopt the innovation. Superintendents of school districts were identified as key figures in supporting the adoption and use of 'modern mathematics':

> ... contrary to general opinion, teachers are not change agents for institutional innovations of major scope ... (the superintendent) may not be ... the original source of interest in a new type of program, but unless he gives it his attention, and actively promotes its use, it will not come into being.
>
> (Carlson, 1965: 11)

This study also compared the ways in which information about the innovation spread from school district to school district. Decisions leading to adoption of the program were dependent on the extent of linkage between superintendents. A sociometric analysis showed that patterns of friendship amongst superintendents were important in determining the rate of adoption of the innovation over the districts as a whole.

Subsequently, other studies extended the analysis of medium effects on adoption by considering how change agents other than superintendents could facilitate educational change in schools. Hughes (1971) followed this trend by contrasting the characteristics of staff in the offices of superintendents in 20 'highly innovative' school districts with the characteristics of staff in superintendents' offices in 20 districts where few or no innovations were adopted in the schools. Halpin's (1966) Organisational Climate Description Questionnaire was used and it was found that staff in the highly innovative districts were more open to change, had a more cooperative relationship with each other, and were more willing to pursue problems to their solution than were staff in the central offices of low innovative school districts. No attempt was made to relate the characteristics of superintendents with the actions of the central office staff, but such a study would be valuable in furthering knowledge of the relationship between the actions of change agents and the strategies of educational leaders.

The foregoing review of research indicates that the educational medium was influential in determining the adoption of educational innovations, including curriculum project materials, in schools. However, there was little evidence of what were the most effective communication channels or strategies by which medium or system level agencies could promote adoption. One means of support according to some of the studies was through articles in teachers' journals.

Implementation as the Criterion

In this research study implementation means the planning and execution of a school program incorporating an innovation. Implementation therefore begins with the acquisition, by users, of the innovation and the decision to use it.

In a recent comprehensive review of the implementation process four major determinants of implementation were identified. These were:

(1) characteristics of the innovation;

(2) characteristics of the adopting unit;

(3) characteristics of macro socio-political units; and

(4) support strategies.

(Fullan and Pomfret, 1975/1977[1])

This section deals with literature pertaining to the last determinant and in particular to three strategies for supporting an innovation by the educational medium. These are: teacher education courses, user participation during the formative stages of the development of the innovation, and change agent support.

Teacher Education Courses One activity which consistently appears to be associated with successful implementation is the involvement of potential users in teacher education courses relating to the innovation. Within more recent curriculum projects there have been more opportunities than before for teachers to attend inservice activities dealing with the use of the relevant curriculum materials. This is the case of 'Man, a Course of Study' (MACOS) and the 'Humanities Curriculum Project' (HCP). In England LEA's provided opportunities for future HCP teachers to become acquainted with the rationale and materials of the course. These opportunities were included as part of the summative evaluation of the Project. In a study of the effectiveness of these inservice programs, student tests consistent with the aims of the Project were used as criterion measures. It was found that there were significant differences in gain scores on these tests by students taught by staff who had undergone an inservice course compared with students taught by teachers who had not taken the course (Hamingson, 1973). This research is important since it suggests that student learning was affected by the planned dissemination strategy associated with the Humanities Curriculum Project.

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[1] This paper was published in mimeo by the Institute for Studies in Education: Ontario, April, 1975. It was subsequently published in Review of Educational Research, 47, 2, 335-397 (1977). This date will be quoted in future references.

Student test performance is not the only criterion which has been applied to the study of inservice strategies. When Crowther (1972) examined the effects of a new social science course in Canadian schools a validated checklist was used to assess the extent to which the materials of the course were used in classrooms. Crowther (1972) found that there were differences in the degree of implementation which was, in turn, associated with the extent to which teachers had attended an appropriate inservice education course prior to and after adopting the course: demonstration and model lessons were of particular benefit to teachers.

Other studies have used questionnaires to assess the impact of innovations. One, by Cole (1971), investigated the implementation of 'Man, a Course of Study' and found that teachers rated the compulsory inservice training course of major importance in determining the success of the course in their schools.

Ashley and Butts (1971) carried out research into the ways in which 29 primary (elementary) teachers implemented a new program of elementary school science. Classroom observations were made and teachers were rated on a number of categories which, taken together, measured the extent of implementation of the program. It was found that participation in inservice programs increased the extent to which the characteristics of the program were implemented.

Each of the preceding studies examined the effects of one innovation. Berman and Pauly (1975), on the other hand, examined a large number by collecting data from a nation-wide sample of schools. The criterion was the extent to which teachers judged that their teaching behaviour was congruent with that of the innovation. It was found that the amount of inservice training undertaken was not related to extent of congruency. There was, however, a 'second order' effect in that when inservice attendance was followed up in the schools by staff faculty meetings, implementation of new programs was high.

User Participation There are a small number of studies which imply that involving potential users during the developmental stage of an innovation is associated with subsequent successful implementation of the innovation. Duet (1972) found that the participation of teachers in the production of a curriculum guide was important in predicting its implementation in schools.

In another study Lamont (1964) compared the use of curriculum guides by an experimental group of teachers who took part in their construction with their use by a non-participatory control group. It was found that the participators used the guide in more ways than the control group. They also had a greater knowledge of the contents and purposes of the guide than did the control group.

Change Agent Support The activities of educational change agents or consultants have also been shown to affect the successful implementation of new courses. Downey et al (1975) in an investigation of the fate of a new social studies program in Canada, found that one-third of a sample of 1,800 teachers rated consultants to be of 'high importance' in assisting with the planning of courses based on the program. The studies by Cole (1971) and Crowther (1972), discussed previously, also reported that the extent of contact with educational consultants was correlated with successful implementation of new courses.

Other research contains similar evidence on the role of consultants. Charters and Pellegin (1973) and workers at Washington University (1970), for example, report that lack of 'face-to-face' support by consultants was a major reason for little success during the implementation of curriculum projects.

Recapitulation : Medium Effects

The studies reviewed considered the roles of the educational medium in the adoption and implementation of innovations. Mechanisms were identified which were associated with the adoption of innovations and with the sustenance of an innovation once it had been adopted. As the research was based in English or American contexts, implications for Australian research must be made carefully.

Studies of adoption have tended to focus on social and political aspects of educational change in the USA. The rate of adoption of innovations increased as the level of support for educational change increased in the community. In the USA school superintendents were identified as key promoters of innovations in schools. Studies in England have stressed the importance of journals as a source of information for teachers who were high adopters of innovations in curriculum.

Successful implementation of innovations in education appears, from the literature, to be related to a number of 'linkage mechanisms' or strategies. These include: teacher education courses, participation in production of an innovation during its development, and the support of advisers or consultants.

A Review of the Role of the User in Innovation

In this review implementation of innovation is taken as the criterion. The characteristics of users which have been associated with implementation are considered.

Successful implementation of an innovation program in curriculum is a prerequisite for judging its effects on students. This has implications for evaluation. Little can be said about learning outcomes unless the extent of implementation has been determined. However, according to a recent review of research, these procedures have not always been followed:

> What is not standard practice in evaluation studies is to describe, let alone measure how the programs in 'experimental' and 'control' situations actually differ from one another. A serious consequence of slighting the alleged 'independent' variable is that elaborately designed evaluation studies may sometimes end up appraising non events, with no one the wiser. There are certainly circumstances in which differences between what researchers regard as 'experimental' and 'control' programs are more fictional than factual, but in the absence of a measurement technology, such circumstances may well go undetected.
>
> (Charters and Jones, 1973: 5)

Many of the research reports which have focussed on implementation were recently reviewed by Fullan and Pomfret (1977). These authors provided an excellent framework by which studies could be compared in terms of methods used for measuring implementation, and factors which appear to be associated with its success in schools. They have also identified two distinct ways by which implementation has been studied. In the first, the *fidelity* approach, implementation is measured in terms of the extent to which the use of an innovation is congruent with the intentions of the developers. The second approach involves an examination of the adaptation of an innovation to user needs. Studies of this second type analyse day-to-day events which affect use and local modifications of an innovation. Studies of this form have been described as using a process perspective (Fullan and Pomfret, 1977).

Fullan and Pomfret focus on the conceptualisation of implementation and its measurement but, there is also some consideration of the determinants of implementation. As outlined earlier, four groups of factors were identified, one of which was the characteristics of users. Fullan and Pomfret (1977) found that there had been little research into the identification of general user characteristics which were linked to successful implementation. The remainder of this discussion is devoted to an attempt to identify these characteristics.

The importance of the role of users in educational change has been recognised in educational research. Miles (1974) observed that the invention, adoption, and adaptation of educational innovations depends a great deal on the users in the schools and colleges for which they were intended. Other writers also emphasise the importance of the users in the school context. In one report on a series of innovations in 293 school districts across the USA it was stated that:

> An innovation's local institutional setting has the major influence on its prospects for effective implementation ... our statistical analysis and our fieldwork clearly shows the project outcomes depending on the characteristics of the project's setting then on any other factor.
>
> (Berman and McLaughlin, 1976: 361)

Smaller investigations bear out this contention. In a report of curriculum innovation in the UK Benson (1973) compared two schools within the same LEA with similar student intakes and school facilities. This research identified factors associated with high use of innovations in one school but not in the other. Characteristics of the staff, particularly the role of the head teacher, as well as the 'social climate' were found to be related to high use of innovations.

Other research has analysed user characteristics from the perspective of educational administration. Ochitwa (1973) considered the general innovativeness of schools in terms of the number of new courses introduced. He used Halpin's (1966) Organisational Climate Description Questionnaire (OCDQ) and showed that efficient organisation of staff and facilities was associated with the high use of new courses.

These studies point to the importance of inter-relationships among users; inter-relationships which are dependent upon patterns of organisation, cooperation, authority exercised by school leaders and the like. Another requirement, however, is that users must have access to new knowledge and methods of teaching. This implies that a link to external resources, which can provide these features when new programs incorporating innovation are being planned and executed, is necessary.

An analysis of additional research reports led to the identification of features which appeared to be regularly associated with successful use of innovation. As a consequence it seemed feasible to define five constructs, or dimensions, associated with successful implementation. Although each does not appear consistently in every report reviewed, it is the case that features allied to one or more of them do. The five dimensions are: (1) Organisation; (2) Cooperation; (3) Openness; (4) Interaction; and (5) Knowledge of the Innovation. They are now discussed in turn, below.

By Organisation is meant the effective deployment of those resources (such as facilities and materials needed other than those provided as part of the innovation) which are available to the users from within the school.

Resources must not only be made available, but also must be efficiently exploited by the users. Note that this distinction may be important in schools and other educational institutions where a sub-group of the total staff is the user and support for implementation from others in the school is required. In particular provision of resources and other means of support to such user groups attempting to implement innovations has been shown to depend on the attitude of the school principal (Yegge et al, 1971; Smith, 1971; Ochitwa, 1973; Benson, 1973). As chief executive officer of the school, directly responsible to the employing authority, the principal occupies a position of influence in the allocation of funds and materials to teachers. But even when principals favour innovations they still, quite properly, expect teachers to continue with a number of ongoing tasks which are essential for school functioning (Sarason, 1971). What appear to be needed, as some studies indicate, are mechanisms within the school by which planning for innovations can be conducted alongside day-to-day tasks which teachers are expected to perform.

An idea of the extent of the organisational difficulties which confront teachers in implementing change can be gauged from two examples of what Hamilton (1976) has called a situational innovation. These are confined to a particular school or school district. Smith and Keith (1971) used participant observation methods of data collection to examine the fate of an open plan approach to teaching in an inner city elementary school in the USA. The new arrangement had the following aims:

(1) to assist pupils to become fully functioning adults;
(2) to allow for individual differences in students; and
(3) to provide the skills, structures and understandings to enable pupils to identify worthwhile goals for themselves and to work independently towards their attainment.

(Smith and Keith, 1971: 22)

The evaluators reported that, at the end of the first year of operation, the program had not been successful. A majority of staff, including the principal, had left the school. A major difficulty was one of organisation. There was not sufficient time or structure in the school program to help in overcoming problems inherent in the coordination of staff schedules such as arrangements for team teaching.

Gross et al (1971) carried out a study using similar data collection methods to those of Smith and Keith. They examined a new curriculum based on open plan methods in an elementary school. The curriculum aimed to:

(1) encourage children to become increasingly self-motivated and increasingly responsible for their own education;
(2) assist children acquire a set of essential skills such as observation and interpretation; and
(3) to make the school an institution that better served the local community.

(Gross et al, 1971: 11)

The school was given special provisions which increased the probability of success over that for 'normal' schools: there were low pupil/teacher ratios (16:1), additional teacher aides and an additional salary loading for staff. The researchers found at the end of a ten-month period that teaching behaviours of the staff had not shifted greatly from those used in their former traditional roles. Among the reasons advanced for the failure of the innovation were those of absence of mechanisms and support structures to assist teachers in their new roles, and unavailability of required materials.

Other North American studies have examined problems associated with the organisation of users when innovations are introduced into schools. Restrictions on the availability of extended periods for planning, inadequate facilities, and few materials were cited as barriers to effective implementation in the work of Crowther (1972), Charters and Pellegrin (1973) and Downey et al (1975). Evidence from one report which compared the effects of a large number of innovations (293) indicates that inadequate space, materials and equipment were among the most frequent barriers to implementation (Berman and Pauly, 1975).

In a survey of factors affecting innovation in schools in South Australia, Gale (1974) reported that teachers rated a well defined organisational school structure high among a list of conditions required for effective implementation.

By Cooperation is meant the extent to which those defined as the users assist each other in implementing the innovation, and the degree to which decisions regarding the innovation are made by all concerned in its use.

The importance of continuity of mutual support has been reported in a number of studies of educational innovation. Smith and Keith (1971) showed that although a staff agreed, in principle, with the aims of an innovation, there were variations in practice. In this case no mechanisms were found by which teachers could reconcile these differences during the initial or later stages of the use of the new program.

Bredo and Bredo (1975), who also studied a school level implementation of new forms of organising a curriculum in the USA, reached a similar conclusion. They stated that:

> although the majority of staff initially supported the project, there were barriers to the solution of problems which arose when the innovation was put into practice, problems which might have been solved through greater staff cooperation. (p19)

Naumann-Etienne (1974) reported that in the implementation of open education in a small sample of primary schools (eight) in the USA, greater communication among teachers and more group decision-making were related to more successful implementation. Comparable findings were reported by Downey _et al_ (1975) in a study of social studies course implementation in Canada. In the UK, Smith (1971) considered the introduction of a new primary science course in eight elementary schools. He found that successful implementation depended, in part, on the extent to which teachers worked together to solve problems which arose in the use of the course.

The Rand survey of numerous innovations shows that regular consultation between staff involved was a necessary requirement for the successful use of new programs. It was reported that:

> if teachers felt they did not participate in day-to-day decisions as the project was implemented, the chance of success, of fidelity to the project design, and of teacher change, were reduced.
>
> (Berman and Pauly, 1975: 61)

The two dimensions discussed above, organisation and cooperation, describe aspects of what could be called the "internal structure of the users". The three remaining dimensions each relate to linkage between users and innovations.

By _Openness_ is meant the extent to which users are willing to find out about new developments, a willingness to be helped and a desire to change.

Gross _et al_ (1971) concluded that lack of motivation to change was an important factor in explaining the failure of the open plan curriculum referred to in detail above. Bredo and Bredo (1975), on the other hand, reported that a lack of initial commitment to an innovatory curriculum was a factor causing its failure. Lukes and Wohleb (1973), who evaluated the introduction of the Head Start Program in the USA, implied that teachers' attitudes towards innovation were important in deciding the success of the implementation of these programs.

Reference has already been made in this chapter to the study of innovativeness in some Canadian schools by Ochitwa (1973). He used checklists to gauge the extent of innovativeness, and collected additional information on subsequent visits to the schools. From a comparison of 'low' and 'high' innovative schools it was concluded that:

> teachers who are prone to change tend to be more curious, are willing to try new things even though it requires more effort ... (these teachers) are more aware of the greater implementation associated with change, and are more 'professional' in their approach toward education and the individual needs of their students.
>
> (Ochitwa, 1973: 42)

By Interaction is meant the extent to which users are linked to other users and to those external resources with a detailed knowledge of the innovation.

In addition to being open to change a user must be in contact with outside agents in order to become familiar with an innovation and to be aware of the problems which may arise in its use.

There are several research findings which have considered associations between interaction and implementation. Hensel et al (1974) suggested that contacts between users in schools and support systems in the educational medium were essential for implementation of innovations. In the USA Yegge et al (1971), who studied the impact of Project Physics, reported that adoption and use of the curriculum was likely if the user:

(1) frequently attended curriculum meetings; (2) had been enrolled in numerous inservice courses; and (3) was frequently sought by other teachers to advise on curriculum matters. In Australia it was shown that use of innovations in schools was adversely affected by lack of communication between users and external resources regarding the innovation (Gale, 1974).

The fifth dimension, Knowledge of the Innovation, appears to require no detailed explication. Research has shown that, even when an innovation has been in use over a period of time, teachers involved have been unable to identify the major features of the innovation (Gross et al, 1971). Similar findings were reported by Crowther (1972), Naumann-Etienne (1974), Gale (1974), and Downey et al (1975). It seems that user clarity about the characteristics of an innovation depends on the way in which information is made available to potential users.

Other reports link the fate of an innovation to user knowledge. Havelock (1973b) carried out a national survey of school districts to determine factors which accounted for the non-acceptance or discontinuance of educational innovations in the USA. Superintendents in 500 school districts were asked to respond to a comprehensive questionnaire from which information was obtained on the number and types of innovatory activities which took place in the schools of each district in the previous year (1971). It was found that the majority of new programs occurred in primary rather than secondary schools. Innovations in curriculum accounted for 18 percent of all innovations cited. Superintendents were asked to nominate an innovation of major importance, a 'showcase innovation', and to rank a number of items as impediments to the use of this program. The highest ranked items were: (1) confusion amongst the staff about the purposes of the innovation; (2) unwillingness of the staff to listen to new ideas; (3) shortage of funds in a school department; and (4) lack of precise information by staff about the innovation. Havelock factor analysed the items in an attempt to identify constructs underlying them. One factor, which accounted for the majority of variance, was described as:

> a strong and pervasive factor related to information about the innovation which suggested strongly the need for improved innovation dissemination and utilisation mechanisms.
>
> (Havelock, 1973b: 207)

Havelock (1973a) has also attempted to conceptualise the factors related to the dissemination and utilisation of innovations by analysing the results of over 2,600 studies in a number of disciplines and fields of study, including education. He identified seven themes to explain these processes. Unfortunately, for this present study, he defined his constructs in extremely general terms as he was striving for a middle range theory; also the constructs appeared not to be orthogonal, and this has been borne out in a recent attempt to use them in a research study (Welch, 1978). Consequently the themes proposed by Havelock are not strictly suitable for this research project.

It is not appropriate here to describe Havelock's themes in detail. However it is essential to note that correspondence exists between four of his themes and the constructs outlined in the preceding discussion. The fact that this correspondence exists does mean that information can be drawn and comparisons made with his extensive survey. The correspondence between Havelock's themes and the constructs named above are as follows: his term 'capacity' resembles the construct Organisation; 'structure' resembles Cooperation; 'linkage' resembles Interaction; and 'openness' is identical to the term Openness defined here.

The research reports reviewed suggested that, when users or organisations rate high on most or all of the five constructs, innovations are successfully implemented. The five constructs can then be considered to define an "Innovation Climate".

CHAPTER FOUR

A FRAMEWORK FOR THE STUDY OF THE IMPACT OF ASEP ON SCHOOLS

In the previous chapter research relating to the adoption and implementation of educational innovations was reviewed. The characteristics of medium or system level factors which were associated with the adoption and implementation of innovations were examined, as were the characteristics of users associated with implementation considered. In this chapter the results of these reviews are used to construct a framework for the creation and analysis of information relating to ASEP.

Significance of the Study

Plans for this research were influenced by a need to document the fate of ASEP within the Australian context and also to provide information of a more general nature about factors which affect the introduction and use of an innovation in schools.

The Relevance of the Study in the Australian Context

The selection of the research questions which guided the study was partly influenced by the need for this study to complement other research associated with the ASEP development. Information about other enquiries, whether they were in progress or completed, was compiled in order to identify areas of research which had not been attempted by others (Owen, 1975). The research reviewed was classified into five areas: studies relating to the production of materials, research concerning teachers, research concerning students, surveys of the adoption and use of ASEP, and 'other' projects not clearly belonging to the preceding categories.

It was found that little work had been done on the documentation of the processes of production of the ASEP materials. This was an area of interest which had become more important in recent times. Research in this field has arisen from an increased interest in the management of curriculum development, in the effectiveness of formative evaluation, and in the identification of factors which influence the paths which a curriculum development project may take. In order to carry out this form of evaluation effectively, Shipman et al (1974) suggested that it was necessary to have a 'resident observer' attached to the project. Some attempt has been made to reconstruct the decision-making processes which occurred during the production of the ASEP materials, through the use of files, but no final report has been written to date.

Two major studies looked at the effects of ASEP materials on teachers. The first was commenced in 1972 before the development of the ASEP materials had been completed. Attitudes to teaching, teaching styles and classroom activities were investigated in a study using a complex multivariate research design. In presenting their findings the researchers suggested that, in the initial stages of use of ASEP materials, teachers need to take extra time at the conclusion of a unit to consolidate what students had learnt from their experiences (Tisher and Power, 1975). Northfield (1975a), in a study still in progress, has been concerned with the use of ASEP materials in 1974 by a sample of 150 Victorian teachers. A measure of their initial knowledge of the characteristics of the materials was made and the extent of their use of the materials monitored over time. Classroom activities of the teachers were investigated to discover whether the suggested sequencing of ASEP materials was being followed. Information relating to students' perceptions of their classrooms was also collected.

There have been a number of studies investigating student performance. One major comparative study, by Fraser (1975), was concerned with the degree, to which students using ASEP materials improved their grasp of scientific knowledge and skills and modified their attitudes to science over time compared with a control group. An additional important part of this study was to compare the students' perceptions of the classroom climates in the control and experimental groups. It was found, in comparisons for 17 separate instructional outcomes, that there were no significant differences between control and experimental groups on 16 of them. On the seventeenth, enjoyment of science, there was a significant difference in favour of the groups of students using the ASEP materials. An investigation of the interaction of instructional methods and 'aptitude' variables showed that the enjoyment of higher ability students remained approximately constant over the duration of the experiment, but that the enjoyment of lower ability students fell away. In the second phase of the study, a learning environment inventory was used and it was reported that:

> ASEP's impact on promoting a favourable classroom climate was appreciable.
> (Fraser, 1975: 11)

The fourth major area reviewed was that of studies of the adoption and use of ASEP at the State or national level. Although one study had included a consideration of these aspects in an investigation of curriculum selection (Beeson and Gunstone, 1975), no attempt had been made to assess the impact of ASEP across Australia. There was, in fact, a dearth of knowledge about the fate of Australia's first national curriculum project on the nation's schools and science courses. Bearing in mind the changing roles of schools in curriculum development it seemed to be extremely important to document as fully as possible the impact of ASEP in terms of its adoption and implementation. In addition, the study of ASEP opened up the possibility of linking adoption and implementation to system and school factors. The major research questions setting down these concerns appeared in chapter One. Other ancillary ones are embedded in subsequent discussions in this chapter.

Deficiencies in Innovation Research

A national level study of innovation in curriculum also appeared to be needed to provide more information relating to the fate of large-scale educational innovations. The literature review revealed a number of deficiencies in studies of this nature and these provided an impetus to conduct a study which would provide data related to these neglected areas.

The first was the monitoring of the extent of adoption and use of materials of a national curriculum project and their geographical distribution. Welch (1968) has suggested that one essential method for assessing the impact of a national project is to determine the degree to which its curriculum materials had been used in schools. Such methods should involve measurement of the degree of use over time. A recent survey in the UK by Booth (1975) collected data on the extent to which materials from the country's curriculum projects in science had been used during the past decade. However, in the USA, it has been demonstrated that appropriate samples of schools and students from which data could be collected have been difficult to obtain (Schlessinger et al, 1973;

Ostendorf and Horn, 1976). For many of the American national curriculum projects there are few reliable figures on sales or use of the materials which were produced by large-scale endeavours.

The second deficiency is related to the use of samples of schools for data collection. There are too few previous studies of curriculum change, the results of which can be generalised to the population for whom an innovation is intended. In one recent comprehensive overview of the implementation of innovations it was noted that:

> ... the majority of studies in this review have apparently involved volunteers. It would be simple if we could be assured that this research can be generalised to populations of volunteers or self selectors. Such is not the case, however. We observed repeatedly in the studies reviewed that researchers made only vague references to the selection procedures. We have no idea how the innovations were presented to potential volunteers: whether they felt free to accept or reject them, what their initial reactions were, and whether these were expressed.
>
> (Fullan and Pomfret, 1977: 382)

As the ASEP materials were designed to be suitable for use in all secondary schools in Australia, it was considered appropriate in this investigation to undertake a national evaluation. Consequently, a national sample of schools representing the population of schools in each State was deemed to be the most appropriate one from which to seek information.

The third area of neglect was the paucity of studies which had examined the fate of new curricula in secondary schools. This can be attributed, in part, to the relatively few innovations in American secondary school curricula compared with those in American primary schools (Havelock, 1973b; Berman and Pauly, 1975). Unfortunately, as students of organisational analysis have indicated, the results obtained from the study of innovations in primary schools cannot easily be extrapolated to secondary schools. Fullan and Easterbrook (1973) have suggested that the attitudes of those involved in change programs differ in the two types of schools. This is due to differences in subject matter organisation, the nature of the students and the nature of the users at different levels of schooling. Users tend to be individuals in the primary school and groups of teachers in the secondary school. Also, there appear to be differences in the extent of planning which takes place associated with the introduction of an innovation. Poll (1970) reported that secondary school teachers appear more reluctant to organise their courses as meticulously as their primary school counterparts.

Key Elements in the ASEP Study

Before methods of data collection and analyses are specified it is necessary to define the elements of this study in terms of the general elements which were presented in Figure 3.1 in the previous chapter. These are shown in Figure 4.1.

GENERAL ELEMENTS	RESOURCE	MESSAGE	MEDIUM	USERS
	↓	↓	↓	↓
ELEMENTS PARTICULAR TO THIS STUDY	ASEP DEVELOPMENT TEAM	PUBLISHED IDEAS AND MATERIALS OF THE ASEP	STATE EDUCATION SYSTEMS	SCIENCE DEPARTMENTS WITHIN SECONDARY SCHOOLS

Figure 4.1 Key Elements in the Study of the Impact of the Australian Science Education Project

In the general paradigm, the key elements were: the resource, the message, the medium, and the users. Two of the particular elements in this study were easily defined in terms of the general case. These were the resource and the message.

> The resource was defined as those responsible for the production of the ASEP materials and the concepts they embodied.

As such, the resource included those who worked at the ASEP headquarters in Melbourne, the consultants employed, and development parties which worked in each State on production of units.

> The message was defined as the published ideas and materials of the ASEP development.

When considering the definition of the medium it was recalled that the resource, the ASEP development team, was not in a position to influence directly the adoption and implementation of the message. Thus the promulgation of information about ASEP concepts and the continued visibility of these concepts was, to a large extent, dependent on situational circumstances within each State educational system. Thus:

> The medium was defined as that group of factors operating at the State level which combined to influence the adoption and implementation of the ideas and materials of the ASEP development.

The final element in the general framework is the users. Here it is appropriate to note that, during the planning of this study, it was considered necessary to identify those groups or individuals who were primarily responsible for the acceptance and use of new knowledge about science curricula in the schools.

In Australian secondary schools groups of teachers, generally under an appointed department head, are responsible for instructing students in a discipline or a subject area. Science teachers in these schools often form a distinctive group for several reasons. First, science subjects have been a fundamental part of the Australian secondary school curriculum for almost a century and, as indicated in chapter Two, they have been studied by nearly all students over the past few decades. This has resulted in the need for specialist teachers of science in most secondary schools. As a consequence a second reason for the distinctiveness of secondary school science departments is the fact that many teachers in these departments teach only the sciences. A third reason is that science teaching occurs in rooms and laboratories designed for a specific purpose, where specialised ancillary staff are often employed to assist in the preparation of materials used in these rooms.

This group of teachers is responsible for the execution of the science program of a school and it appears that, in general, entire science department staffs become responsible for deciding on the school's science curriculum. This conclusion is borne out in two Australian studies (Beeson and Gunstone, 1975; Northfield, 1975b). Northfield, for example, found that in more than two-thirds of 118 schools approached, the entire science staff was responsible for planning and implementing the science syllabus.

However, although a science staff may constitute a discrete user group within a school, each member is nevertheless affected by other school factors. This was recognised in this study and incorporated in the definition. Thus:

> The users were defined as the members of staff who taught science within the school.

These definitions enabled the next phase of the planning to be carried out. This involved the study of the influence of particular elements on the adoption and implementation of the ASEP ideas and materials.

The Role of the Medium

Waring (1975) has stated that medium effects can have a large influence on the fate of curriculum projects. Resource systems and medium effects may have conflicting interests. The impetus for curriculum reform in science stems from the interaction of science, society and developments in educational theory. The translocation of this reform to users may be filtered by political influences. These become apparent through the policies of educational authorities and the roles of key personnel who are in a position to influence the curriculum in the schools for which the innovation was intended.

The availability of the ASEP materials offered an opportunity to carry out a comparative study of how different educational mediums reacted to the same innovation. As discussed in chapter Three, research of a comparative nature has rarely been attempted in studies of educational innovation. This aspect of the study was concerned with the identification of those factors which influenced the adoption and use of the ASEP materials into the schools in the different mediums, the State educational systems.

Figure 4.2 shows the way in which the influence of medium effects was conceived and made the basis for collection of data. It can be seen that a distinction is made between a theoretical and an operational level of analysis.

At the theoretical level it is postulated that, when an educational medium provides support for an innovation through its policies and programs, the schools within the medium have the opportunity to change, to base their curricula on the ideas and materials of the innovation.

This concept was made operational after a consideration of the review of medium effects which was presented in chapter Three. The results of studies suggested that four linkage mechanisms or key strategies were associated with high adoption and maintenance of an innovation.

	Dependent Variables		Independent Variables
Theoretical level	Extent to which schools across State based their science programs on ASEP ideas and materials.	←	Support by State level agencies for use of ASEP ideas and materials.
	↓		↓
Operational level	Adoption and use of ASEP materials across State.	←	Extent to which (1) journal articles, (2) teacher education courses, (3) user participation, (4) change agent contact, emphasised ASEP.

Figure 4.2 Interrelationships Between State-Level Factors and their Effects on the Adoption and Use of ASEP Ideas and Materials

The first were articles in journals. Such articles were shown to be an important means by which teachers obtained information about the innovation. Knowledge of the innovation has been shown to affect the adoption decision and also the implementation of an innovation. It was suggested that, where more information about ASEP was available to teachers in journals which they customarily consulted, there was a greater chance that adoption and use of ASEP materials would occur.

The other key strategies affecting curriculum change which were shown to be determinants of implementation of innovations were: formal courses of teacher education, user participation in the development of the innovation, and contacts with change agents. An aim of this study was to consider these four strategies, to assess whether they were associated collectively with the influence of ASEP on school science curricula and to evaluate their relative effects.

At the operational level, the extent to which science curricula across the medium or State educational system were affected by ASEP can conceivably be measured by the number of schools which had adopted and used ASEP materials and the extent of adoption and use of these materials in the schools. Although adoption and use are, by themselves, not measures of the implementation of the ideas of the innovation, it is contended that they are suitable criteria for studying State level effects.

The foregoing discussion implies that curriculum change can be conceived as a two-level process. The first involves the medium in informing teachers and providing maintenance for the innovation. The second involves the users who plan the curriculum around the innovation. The choice of the criterion for examining medium effects assumes that, when adoption and use is high, linkage mechanisms have been provided which create a high potential for implementation of the innovation by users.

The diagram in Figure 4.2 suggests a second level of analysis. This involves a detailed consideration of the support State educational systems gave to the ASEP endeavour and an analysis of the factors which promoted or inhibited introduction and use of materials intended for curriculum reform in science in the period of the ASEP development.

The Role of the User

Figure 4.3 shows the way in which the analysis of user effects was conceived and made the basis for data collection. There are two levels to be considered. At the theoretical level it is suggested that the extent to which the ideas of ASEP affected the planning and implementation of science courses can be explained by two factors. The first is the commitment of a school to the ASEP materials. The second is the Innovation Climate within the user group, the science department[1], within the school. Underlying the selection of these factors is the assumption that, in order for ASEP to make an impact on the execution of science programs, the ASEP materials needed to be available to teachers. The greater the amount of these materials available, the more the science program can be based on the ideas underlying the ASEP development. The inclusion of the second factor, the Innovation Climate, results from the findings obtained from a review of studies of educational change presented in chapter Three. This review led to the suggestion that the implementation of programs based on new knowledge required a supportive atmosphere within the user group, one which permitted resolution of problems associated with the implementation of innovation. Successful implementation also required that users have an open attitude to change.

At the operational level it was necessary to develop a conceptualisation of implementation and then apply the concept to this study. The emphasis was on investigation of curriculum development in science courses.

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[1] In section 4.2 the users were defined as members of staff who taught science within the school. For ease of discussion, this group will be referred to as the science department in this report.

Two distinct approaches have already been discussed briefly in chapter Three. The first was the fidelity perspective. Evaluators using this approach make judgements of the extent of implementation by comparing the behaviours of teachers and students in the classroom with those intended by the developers of the innovation. Attention is thus directed to the ultimate stage of the transfer of the ideas of the innovation into learning situations. The approach assumes that the characteristics of the innovation are sufficiently well defined so that they can be measured by checklists or by observation.

	Dependent Variables		Independent Variables
Theoretical level	Congruence of school science programs with ASEP ideas.	←	(1) Commitment to ASEP materials. (2) Innovation climate.
	↓		↓
Operational level	Implementation characteristics.	←	(1) Adoption and use of ASEP materials. (2) User: (a) organisation (b) cooperation (c) openness (d) interaction (e) knowledge of the innovation.

Figure 4.3 Interrelationships Between User-Level Factors and their Effects on the Implementation of ASEP Ideas and Materials

Many observers have, however, expressed reservations about research concentrating solely on an examination of those characteristics of an innovation which can be specified in advance. This arises because of the nature of curriculum planning in schools which may require an innovation to be adapted according to the needs of teachers and pupils in a diverse range of settings (Brickell, 1975). The notion that a curriculum package should be used strictly in accordance with specifications laid down during its development has been questioned by educators who argue for the rights of teachers to consider alternatives to those specified. Leinhardt (1974) argues that teachers can make improvements on the ideas contained in large-scale curriculum projects. The recognition of these features has led to the emergence of a process perspective for the examination of the implementation of programs based on curriculum projects. In this approach the adaptation of materials arising from these projects in order to satisfy local needs is studied (Ben-Peretz, 1975).

In a recent paper Gephart (1976) discussed the crucial role of users in the process of implementing innovative programs. He asserted that the responsibility for program outcomes rests jointly on the developer and implementer since there is a high probability that any program might be successfully adapted. This implies that there is an onus on the evaluator to assess the appropriateness of local adaptation.

The question of which form of implementation was to be used as the criterion was particularly relevant to the study of the reaction of science departments to ASEP. Classroom observations, alone, would have emphasised the fidelity perspective. A wider consideration of the impact of ASEP on users, which included a study of the adaptation of ASEP materials, would have emphasised the process perspective. A number of factors were taken into consideration in making the choice between the two approaches. It was recognised that ASEP materials were first released during a period when devolution of authority to schools for curricula was taking place. The period was one where there was an evolution of school-based science programs and in many instances ASEP was expected to be a direct influence on their development. Moreover it could also be expected that there would be changes over time, a feature of curriculum which, according to Harding et al (1976), has often been neglected in innovation research. Now schools were not directed to adopt ASEP in their courses so there was a definite probability that many science departments would not use ASEP units solely. Given these conditions, it seemed more appropriate to examine the influence of the ASEP ideas and materials on curriculum planning from a process rather than a fidelity perspective.

Studies of this nature must still commence with a set of criteria and, where necessary, include descriptions and explanations of deviations from these in terms of factors such as deficiencies in the understanding of the innovation by the users, barriers to the implementation of certain aspects of the materials, or justifiable adaptations which are due to unique local conditions.

For this examination of the impact of ASEP on school science programs a set of criteria was assembled. This was based on the analysis of a document on the stated ideas of the developers (ASEP, A Guide to ASEP, 1974). Seven dimensions were identified from the analysis. It was concluded that there would be congruence between the intentions of the ASEP developers and a school science program if:

(1) there was an interdisciplinary approach rather than one in which teaching was centred on traditional subject disciplines;

(2) in planning and in practice, the ASEP materials were used at the appropriate year levels;

(3) use was made of ASEP teachers' guides, student texts and record books;

(4) consideration was given to the intellectual levels of child development and reading level information provided by ASEP;

(5) use was made of the ASEP core and option system;

(6) enquiry-based teaching methods predominated; and

(7) evaluation took place using student administered tests at the appropriate intervals.

Thus the concept of implementation contained a number of dimensions and an assessment of the extent of implementation was to be gauged by a profile rather than a single measure.

With the implementation criteria established it was then necessary to consider the ways in which the constructs which made up the Innovation Climate could be made operational. The first step was to modify the statements of each construct, introduced in chapter Three, so that they applied to the situation in which ASEP was being adopted and used by science departments in schools. The working definitions appear below.

(1) Organisation; the extent to which resources and facilities made available by the school are effectively deployed by the science department,

(2) Cooperation; the extent to which staff of the science

department assist each other in the day-to-day functioning of the department, and the degree to which decisions are made which involve the science department as a whole,

(3) Openness; the extent to which the science department expresses a willingness to find out about new developments, a willingness to be helped and a desire to change,

(4) Interaction; the extent to which the science department is linked to other users, to others with greater knowledge of trends in curriculum development, and

(5) Knowledge of the Innovation; the extent to which the science department knew of the basic characteristics of the ASEP development and its materials.

There were three major objectives in the study of users, the science departments in schools, concerning the impact of ASEP. The first was to determine the extent of implementation of ASEP ideas in the school science curriculum. The second was to determine the commitment to the materials and the Innovation Climate among the users. The third was to examine whether there was an association between implementation on one hand, and the commitment to ASEP and the Innovation Climate on the other. These aspects were considered to be the crux of the study of user characteristics.

Concluding Comment

The rationale for an evaluation of the effects of ASEP on science teaching in Australian schools and of its fate took into account both educational medium and user effects. Underlying assumptions were that for curriculum change to take place based on a major curriculum innovation there needed to be strong system level support for users and, in addition, users who, in terms of their attitudes and general organisation, were able to receive and implement the innovation.

CHAPTER FIVE

THE PLANNING AND CONDUCT OF THE EVALUATION

Introduction

When plans for the collection and analysis of information were formulated, note was taken of the current debate amongst evaluators regarding the types of evidence which should be admitted, and the methods to be used in judging the worth of educational programs. A polarisation of opinion has been evident. On one side there are those who contend that attention should focus on program objectives and that theoretical considerations linking objectives to their determinants should guide the collection and analysis of evidence. This approach has generally involved collection of data on a scale of magnitude which allows for psychometric analyses; analyses which are designed to provide information from which generalisations about the effects of the program and its antecedents can be made.

The use of objectives in the conduct of educational evaluation has been the subject of criticism by those whom Stenhouse (1975) has called the 'new wave' evaluators. According to Ainley (1978) their reservations concerning the objectives approach are that it:

> emphasises products rather than processes, it is usually confined to a narrow range of cognitive outcomes, it limits or excludes the detection of unexpected outcomes, and it presents a uniform picture of the program regardless of the setting.
>
> (Ainley, 1978: 4)

Thus the 'new wave' evaluators such as Stake (1967), Parlett and Hamilton (1972) and MacDonald (1976) have been concerned with a broad view of evaluation. A factor which has influenced the thinking of proponents of this form of evaluation has been the audience for whom the results are relevant. It has been argued that school administrators and teachers are more likely to respond to an appraisal of a program in the context of their school rather than be influenced by the results of an evaluation of the program on a large scale. The approach of the 'new wave' evaluators, in practice, has been through participant observation resulting in case studies of the effects of programs in specific contexts or settings. Whereas theoretical considerations were important in the objectives approach to evaluation, the 'new wave' evaluators largely reject the role of theory because it encourages the oversimplification of the complexities of school settings.

Recently it has been recognised that the division between these extreme views is artificial and unhelpful. In reality different methods are used in different educational evaluations: the methods used are those which are suitable for the research question being studied (Maling Keepes, 1976). Also, there seems to be no valid reason why theoretical considerations should not underpin all evaluations where possible, whether they emphasise psychometric or case study approaches.

When this study was in the planning stages a combination of data collection techniques and methods of analysis were contemplated. Notice was taken of the advice of Sieber (1973) who commented, in the context of sociological research, that there are benefits to be gained from the employment of survey methods and case study approaches within the one study.

In this evaluation the study of medium and school effects was guided by a theoretical framework. The qualitative field work was based on an 'illuminative' approach (Parlett and Hamilton, 1972) but was consistent with the advice that one should, when using such methods:

> begin with the necessary openness and receptivity holding constricting assumptions in check, but having assembled on the sidelines, resources in terms of available theoretical orientations which might prove useful in 'making sense' of the situation being investigated.
>
> (Parsons, 1976: 132)

This approach has been used in other evaluations. For example Goodlad *et al* (1974), in a study of educational reform in American schools, assembled a set of factors which affected reform by reviewing the relevant research literature. This information was used as a basis for the data collection which took place using case study methods.

Selection of Data Collection Techniques

Decisions concerning the collection and analysis of information were dependent on the nature of the three research questions which formed the basis for the study. These were outlined in chapter One. First, it was the intention to determine the penetration of ASEP materials into secondary schools throughout the country and, as such, this aspect focussed upon the impact of ASEP at the *national* level. Secondly, the study attempted to determine the factors which explained differences between the adoption and use of ASEP materials in different educational mediums or State systems. This facet was focussed at the *State* level. Thirdly, it was the intention to evaluate the influence of ASEP on curriculum planning in science departments and hence this aspect focussed upon the *school* level. These three levels of enquiry formed the basis of a comprehensive coverage of the impact of ASEP on schools, and an analysis of the factors which affected its adoption and use.

Once the levels of investigation had been determined, attention then focussed on the research questions with a view to selecting suitable data collection techniques. Table 5.1 shows that different methods were used to provide information for each research question; also, within each section of the study, a range of methods were employed. The reasons underlying the use of these methods are now outlined.

Table 5.1 Methods by Which Information was Obtained

Research Question	Unit of Analysis	Modes of Data Collection
Extent of adoption and use of ASEP materials.	(1) Nation (2) State	(1) Investigation of sales records of distribution. (2) Questionnaire
Adoption and use of ASEP in relation to system level effects.	(1) State	(1) Questionnaire (2) Analysis of documents. (3) Interview
Effect of ASEP on curriculum planning in science.	(1) School	(1) Questionnaire (2) Analysis of documents (3) Interview (4) Observation

Extent of Adoption and Use of ASEP Materials

The objective in this section was to investigate the selection and use of ASEP materials by science departments in secondary schools across Australia.

One aspect of this investigation was to examine the preference of schools for ASEP units, with respect to their content and their level of complexity. This data was used to determine the ways in which teachers introduced the innovation into their courses. The choice of ASEP units was monitored, over time, by examining the records of the sole distributor. Sales of materials have been used in the study of the impact of other large-scale curriculum projects, but data from private book publishers has often been difficult to obtain and has been considered to be of low reliability (Watson, 1978). That there was a sole source of ASEP materials, the Stores Branch of the Victorian Education Department, overcame problems encountered in other studies.

However, the evidence available from this source did not answer questions regarding the extent to which schools had adopted and used ASEP materials. A questionnaire was used to obtain this information and to collect other data from which temporal and spatial aspects of the impact of ASEP could be examined.

Impact of ASEP and Medium Level Effects

In this section of the study the extent of adoption and use of ASEP materials in schools in each State were compared. This information was collected from schools by survey methods. Differences between States in the overall extent of adoption and use was then linked to the means by which the ASEP development was supported in each State. Selection of the evidence to be collected regarding each State system was based on the framework for the study which was presented in chapter Four. The findings of other relevant research provided a 'middle range' theory which identified strategies designed to facilitate the adoption and implementation of ASEP materials in the schools. This information was collected from teachers by survey methods.

The study also attempted to provide explanations for the extent of support for ASEP by the educational medium in each State. Information needed for this facet of the research was obtained from sources located at the system rather than the school level. Documents held by Education Departments and Examination Boards in the respective States were studied in order to gauge the influences of factors such as outline syllabuses, changes in assessment procedures and other organisational factors on the introduction and use of ASEP materials into the science programs of secondary schools.

Evidence was also collected by interviewing persons who held influential positions in science education in each State. These included administrators, curriculum consultants, advisers and inspectors of science. This evidence was also valuable in explaining the degree of support in each State for schools in their use of ASEP in their science curriculum.

Effects of ASEP on Science Courses

The final aspect of the study was an analysis of the implementation of ASEP in school science curricula and a consideration of the school level factors which affected implementation. In chapter Four it was postulated that the extent of implementation of ASEP across the science program of a school would depend on:

(1) the extent of commitment of the science department to ASEP materials; and

(2) the Innovation Climate of the science department.

Information on implementation was based on criteria which had been assembled from an analysis of the intentions of the ASEP developers. A checklist was used in the schools to record the extent of implementation and this required that visits be made to schools so that observations could be made of classroom activities. Additional information was collected from science teachers and others, such as laboratory assistants, regarding the way the ASEP units were incorporated into the total science program. Recognition that the extent and nature of implementation could vary with time, and that this aspect should be monitored, meant that a series of visits were made to a given school at regular intervals. The availability of resources restricted the number of schools which could be included in the study of implementation.

The choice of schools to be visited was based on an analysis of data collected by questionnaire. The data enabled measures of the 'independent' variables; the extent of commitment of the school to ASEP and the Innovation Climate, to be assessed for every school involved in the survey. Multivariate techniques, including cluster and discriminant analyses, were used to select a small number of schools to be selected for intensive study. A detailed account of these techniques appears in chapter Nine of this report.

The Population and The Sample

The Population

As this study was concerned with issues associated with school and State levels as well as a national perspective, care was given to defining the population for the study as well as specifying the sample. It was noted that, frequently, research reports do not contain a clear specification of the population from which a sample is drawn. In this study the population of schools was defined as:

all secondary schools in Australia which included students who were taught in at least three of the year levels seven to ten.

Within these schools the users were defined as:

all teachers of science within the school.

A teacher of science was defined as a person who:

in 1975, taught at least one class grouping of science at one or more of the first four year levels in the (secondary) school.[1]

The Sample

The population of schools was located in all States of Australia, in different regions (metropolitan and non-metropolitan), represented different types of schools (government, independent and Catholic), and contained different numbers of students. Furthermore, the number of schools varied from State to State. Accordingly it was decided to follow procedures adopted by the Australian Council for Educational Research (ACER) in its national level studies and in mid-1975 a sample of schools was selected.[2] The sampling frame used was divided into 42 strata on the basis of number of States, type of school, and school location.

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[1] This definition applied in New South Wales, Victoria, Tasmania and the Australian Capital Territory. In Queensland, South Australia and Western Australia, where there is one less year of secondary school education than in other States, the definition was amended to read 'three' rather than 'four'.

[2] The procedure was similar to that outlined in:

Rosier, M.J. and Williams, W.H. 1973 The sampling and administration of the IEA Science Project in Australia 1970: a technical report. Hawthorn, Victoria: Australian Council for Educational Research.

Two important factors influenced the selection of schools. It was considered necessary that the selection should be random, and that the sample of schools chosen should reflect the distribution of schools in the total population according to the stratification by State, type and location. A simple random sample would not have been the most suitable because firstly, it would not represent each stratum accurately and secondly, the final sample may have overemphasised smaller schools, compared with the student numbers they serve.

It was deemed to be more appropriate to draw a stratified probability sample to select a set of schools from which to collect information. In the sampling schools had a probability of selection which was proportional to the number of science teachers in the school. Altogether, approximately 300 schools were selected: 50 in New South Wales, Victoria, Queensland, and South Australia, the more populous States, and 40 in Western Australia and Tasmania. In the Australian Capital Territory there were just 20 schools in total and they were all included.

Methods of Data Collection - The Questionnaires

Two questionnaires were constructed. One, the 'Teacher Questionnaire', was designed to be completed by teachers of science; the other, the 'School Questionnaire', by the Head of the Science Department in the school.

The Teacher Questionnaire was designed to gather details about the extent of use of ASEP materials and other texts in science programs, opinions about user and medium level factors which influenced the use of ASEP units, and teacher reactions to the ASEP materials. This questionnaire also included a set of statements from which measures of the Innovation Climate in the science department were obtained. In addition, details such as age, sex, and experience of the science teachers were collected.

Each questionnaire was subjected to trial and, at that time, was divided into two parts. The first contained all the items except those designed to measure the Innovation Climate in the school. The first part was examined by experts in questionnaire construction from ACER and University staffs who were asked to judge the logical consistency of the items and their layout. This part was then submitted to five experienced science teachers before being modified to produce the final version.

The second part of the Teacher Questionnaire contained statements each of which was designed to measure an aspect of the five scales which made up the Innovation Climate. The constructs: Organisation, Cooperation, and Openness were tapped by asking teachers their opinions about the science departments in which they worked. A five-point Likert scale using categories from 'strongly agree' to 'strongly disagree' was employed for these statements. Initially ten items were written for each of these scales. To reduce the probability of indiscriminate responses approximately one-half of the statements were written as positive ones, the remainder as negative.

The construct Interaction was measured through a series of questions about the extent of each teacher's professional activities which linked him with developments in science education in a given period of time. The period chosen was the two years immediately preceding October 1975, when data were collected by questionnaire. In the first instance ten items were written for this scale.

The construct Knowledge of the Innovation was tapped using nine items from a previously validated scale used by Northfield (1975b) in a parallel study of implementation of ASEP materials.

The scales which made up the Innovation Climate were subjected to several validating procedures before being included in the final form of the Teacher Questionnaire. Gardner (1975) has stressed that it is essential when preparing and trialling attitude scales to use a sample comparable to the population to which the instrument(s) are ultimately directed. In this study, 160 science teachers in 28 Victorian schools completed this trial form of the questionnaire. This was considered to be a suitable sample in order to meet Gardner's requirements.

Gardner (1975) also suggested that attitude scales should be sensitive to allow a range of scores to be attained by the respondents. A sensitive scale, he maintains, is required in order to minimise the proportion of total variance contributed by the error variance. The scales were also checked for their internal consistency or internal reliability using the alpha coefficient. Following the advice of Nunnally (1967) values of 0.60 or better were regarded as acceptable.

Point-biserial correlations of each item with each scale were also examined. A number of items which correlated moderately (0.30 or greater) with two or more scale totals were removed. While this had little effect on the alpha coefficients it did increase the uniqueness of each scale, lowering their overlap and interdependence. After several examinations of the scales 36 items, eight for the Knowledge scale and seven for each of the other scales, were included in the final form of the Teacher Questionnaire. The characteristics of each scale, and their intercorrelations are listed in appendix 5/1. The final form of the Teacher Questionnaire is included as appendix 5/2.

The School Questionnaire items were written to gather information on the amount of ASEP materials adopted by the school, reasons for purchase, hindrances to purchase, and other pertinent details such as school size and time spent on science in the school. Similar procedures were used for writing, trialling, and modifying the School Questionnaire as for the first section of the Teacher Questionnaire. Only after detailed examination and trials was the final form of the Questionnaire produced. It is included as appendix 5/3.

Administration of the Questionnaires

After the sample of schools had been drawn letters soliciting the cooperation of teachers in the study were mailed to school Principals. In the cases where no response was received to the letters liaison officers contacted schools. As a consequence the response rate increased. Details of the rate of response are listed in appendix 5/4. Ultimately, about 99 percent (289/293) of the sample of schools agreed to receive the questionnaires.

Questionnaire packages were mailed in October 1975 and included details for administration and a supporting letter from the Australian Science Teachers' Association (appendix 5/5). A reminder note was posted one month after the initial mailing to those schools which had not returned the completed questionnaires. The return rates are listed, by State, in appendix 5/4 and the details for Australia are shown in Figure 5.1. Ultimately a school response rate of just over 90 percent was achieved with little fluctuation between States. The response rate curve shows a remarkable likeness to that reported in a study by Isaac and Michael (1971) in which mailed questionnaires were used.

In total, 267 school returns were received and after deleting seven because of incomplete information, 260 School and 1699 Teacher Questionnaires were retained for the data analysis. This represented a net return

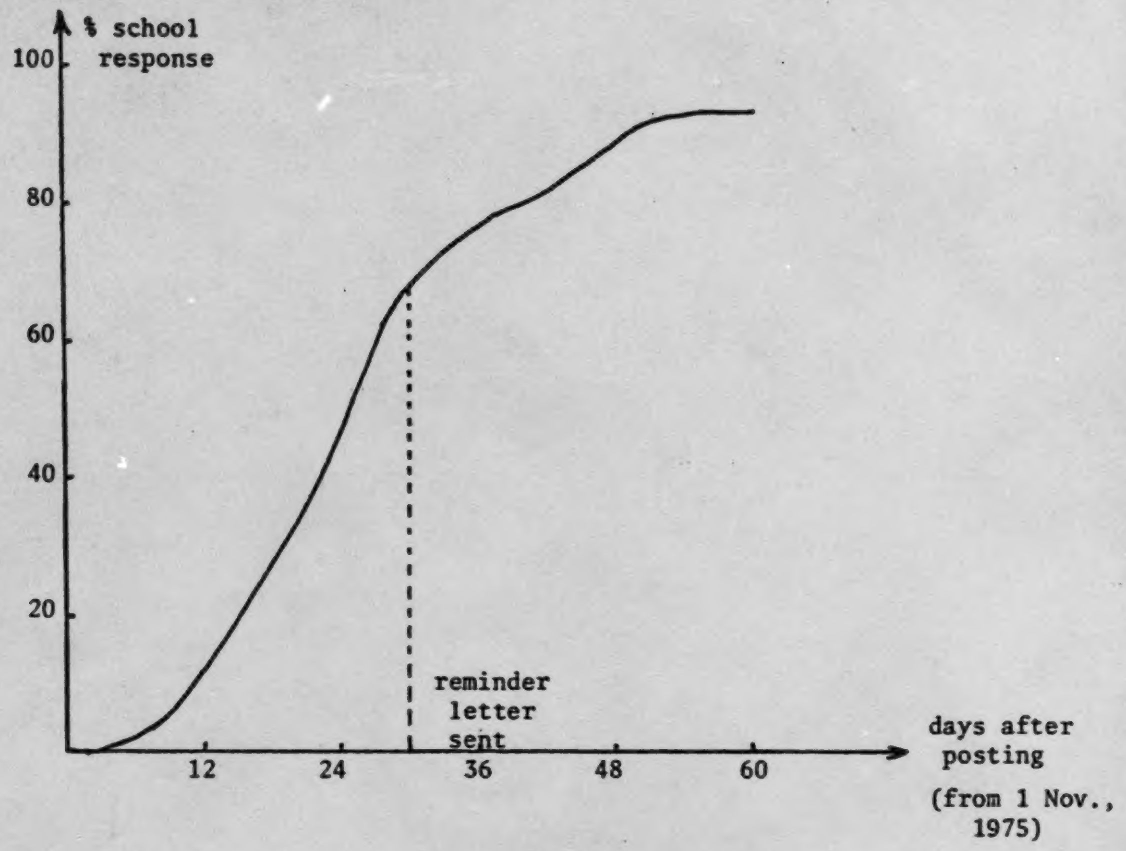

Figure 5.1 Response Rate from Schools as a Function of Time

rate of 89 percent of the original sample. An intriguing feature about the return of questionnaires was that the response rate from schools which originally agreed to participate was far higher than that of those who agreed after further prompting. Of the former group, 11/235 (4.7 percent) failed to respond, whilst in the latter 11/54 (20.4 percent) did not return the questionnaires. This highlights a difficulty in obtaining returns from those who, for one reason or another, show little inclination to cooperate in a study from the outset.

When the questionnaires were received from a school all information was entered into a composite file made up of data from the School and Teacher Questionnaires.

The five scales which made up the Innovation Climate were checked to ensure that each retained its characteristics when teachers from all States were included in an analysis. The results of the subsequent factor analysis of the scales are listed in appendix 5/6. This analysis showed that two items had changed scales from the trial stage to the large-scale data collection. These items were deleted leaving two scales with only six items. The final characteristics of the five scales used in the remainder of the study are set out in Table 5.2.

All scales had acceptable reliabilities which ranged in value from 0.64 to 0.77 and were suitably sensitive in terms of the range of scores. In general, each scale was considered to be unique; the intercorrelations with two exceptions, being 0.20 or less. These were between Interaction and Openness (correlation = 0.36), and between Organisation and Cooperation (correlation = 0.33). In these cases the amount of variance of one scale which was explained by the other was less than 15 percent; this was considered acceptable. Items which contribute to each scale are listed in appendix 5/7.

A score was calculated for each teacher for each of the five scales. A principal component analysis on each individual scale enabled the relative importance of each item to be determined and the use of the factor score coefficients, which were calculated by this process, enabled the most accurate score to be obtained (Child, 1970).

Allowance for Non-Response and Weighting Factors

In order to make satisfactory predictions about the population of Australian schools it was considered necessary, not only to draw an appropriate sample, but also to achieve a high response rate. When the response rate is less than 100 percent, it is possible to extrapolate from the returns received to the population by applying appropriate correction factors.

Table 5.2 Statistics Relating to the Innovation Climate Scales Between Teachers (N=1699)

Scale Name	Organisation	Cooperation	Openness	Interaction	Knowledge
Mean Score	21.9	19.9	21.9	13.4	5.5
Standard Deviation	4.9	4.2	3.9	6.0	2.2
Reliability (coefficient α)	0.68	0.77	0.64	0.74	0.64
Number of Items	7	6	6	7	8

Range and Intercorrelation	Range	Organisation	Cooperation	Openness	Interaction	Knowledge
Organisation	8-29	-	0.33	0.11	0.01	0.04
Cooperation	7-27		-	0.15	0.09	- 0.01
Openness	8-27			-	0.36	0.10
Interaction	8-35				-	0.20
Knowledge of the Innovation	1-8					-

A comparison of the number of sample schools representing each stratum with those which finally responded enabled the calculation of correction weights. Using these, best estimates of population statistics were obtained.

The correction factors were also used in the first of a two-phase procedure for the estimation of national trends. In the second phase State means were weighted after taking into account the relative proportions of population to sample size. The fact that sample sizes in each State were approximately similar meant that the weighting factors varied depending on the size of the population, being greatest for strata in New South Wales and smallest for those in the Australian Capital Territory.

Values of the correction and weighting factors are set out in Appendix 5/7. Allowance for the variation in population : sample size between States was made by using the proportion of 14-year-olds in each State as the point of comparison. This resulted in a set of 'stateweights' to be applied when calculating a national value for a given variable from the data of the samples in the States.

Other Methods by Which Information was Collected

Interviews

As noted previously, interviews were used in two facets of this research. In the first, data were collected from people working at the system level which were used in an analysis of the extent of support for ASEP implementation by the educational medium in each State. In the second, the school visit phase, teachers and others, such as laboratory assistants, were the source of information regarding the incorporation of ASEP into the school science curriculum. Teachers were asked to specify the ways in which their science program had been organised rather than to discuss the way in which decisions had been made to use ASEP materials. This was considered to be a less threatening means of obtaining information about the use of ASEP in the science curriculum. The researcher attempted, in all interviews, to outline the scope of the study, to explain to the respondent how the school had been selected, and to stress that information collected would be regarded as confidential.

Wherever possible conversations were arranged in the schools so that they could not be overheard by a third person. An interview outline (appendix 5/8) guided the researcher but when diversions appeared to be appropriate, respondents were encouraged to discuss aspects of the planning of the science department which were unique to that group of teachers.

The interviews were a major source of data collection and efforts were made to develop techniques which were designed to put the respondent at ease (Dyer, 1976). Interviews made at both system and school levels were tape recorded. Notes made during replays of the tapes were added to evidence obtained by other methods.

Documentation

Documents were also a source of data in the study of system and school effects. Syllabuses, student tests and reports of student progress were examined in the schools. Records of meetings, outline curriculum statements, and position papers were sources of evidence from State Education Departments.

Observation

Observations of science classes were carried out in all schools visited. Implementation was assessed using a technique similar to that proposed subsequently by Evans and Berman (1977). A checklist based on the characteristics of the ASEP materials was constructed (appendix 5/9) and a 'yes' or 'no' was recorded to indicate whether a characteristic was implemented or not. Space was also left for the researcher to make comments on the factors which appeared to influence implementation of the individual ASEP characteristics in each classroom.

The Timing and Sequence of the Study

There was a planned sequence for the acquisition of information. Data was first collected from the entire sample by the questionnaires. Analyses of this information identified systems and schools for subsequent intensive study. Further evidence about these systems and schools was collected during visits to the States. The methods just outlined were employed at the system and school levels.[3]

The collection of data occurred in the period between October 1975 and August 1977. The first ASEP unit became available in March 1974 and the remainder were released periodically up to January 1975. The period in which the research took place thus encompassed the years in which schools had their first opportunity to consider the total range of the ASEP materials.

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[3] Multiple stage research involving surveys and field work have been recently reported by Roebuck et al (1974), and Wideen and Butt (1974).

CHAPTER SIX

ADOPTION AND USE OF ASEP - THE NATIONAL PERSPECTIVE

Introduction

This is the first of five chapters devoted to a discussion of the findings of the study. There is a progression from a macroscopic to a microscopic examination of the impact of the ASEP development in this discussion. This chapter considers national level aspects and forms the basis for the subsequent presentation of the other results and analyses. In chapters Seven and Eight the influence of State or medium level factors are considered, and in chapters Nine and Ten attention is focussed on the way schools used the ASEP materials in their science programs.

The rationale underlying the collection and analysis of large-scale data in the study of the effects of a national level curriculum project has been outlined by Welch (1968) who stated that:

> this approach has strong appeal of simplicity and practicality. Admittedly, assessment of the impact of a new program by counting the number of students using the material is not a basis for final judgement of success. This criterion ignores the quality dimension, and probably is a function of propaganda and advertising. But a complete appraisal of the impact of these programs is impossible without it.
>
> (Welch, 1968: 223)

In this study the adoption of ASEP materials into schools across Australia was one means by which the impact of ASEP was assessed . This criterion also enabled analyses of the impact of the ASEP development over time, and with respect to location of school. These two aspects of the study of educational innovation have often been neglected in innovation research. Studies of the fate of an innovation over time assist in the determination of whether or not it has been discontinued or incorporated into the programs of users (Harding et al, 1976). Studies of the variation in adoption and use of an innovation with school location have been shown to provide important clues from which conclusions can be made about the effects of system or medium level factors (House, 1974). These aspects were considered to be necessary for a comprehensive description of the fate of the ASEP development in Australia.

Adoption of ASEP Materials

The impact of ASEP at the national level was judged in one way by considering the adoption of ASEP textual materials by schools. Ownership of materials associated with an innovation is, by itself, not a direct measure of influence. However the degree to which a school adopts materials is an indication of the extent to which it has committed its financial resources to the innovation. As such, ownership is a measure of the potential the materials have to influence relevant programs in the school.

ASEP produced three packages of materials which were available to schools. These were: (1) inspection, (2) module, and (3) record packs. Inspection packs were the 'teachers' guides' for each unit. Record packs contained workbooks for students. The module packs contained 10 student workbooks and, because these were essential for students, the module pack was considered the logical unit for a measure of the potential value of ASEP materials in the schools.

When questionnaires were distributed in October 1975, the Head of the Science Department in each school was asked to indicate the extent to which the school had adopted ASEP module packs. The data related to the responses are given in Table 6.1 which is divided into two parts. In both

Table 6.1 School Adoption of ASEP Module Packs. Australia (N=300)

6.1(a) Adoption Within Each Time Interval

	Percentage of Schools in Each Interval		
Number of Module Packs Adopted	Up to Dec.1974	In the Period Jan.-Oct.1975	In the Period Nov.1975-Feb.1976
0	54	50	66
1 - 20	27	30	24
21 - 80	17	18	10
> 80	2	2	0
	100	100	100
$\bar{X}$	11.0	12.3	6.9

6.1(b) Progressive Adoption

	Percentage of Schools in Each Interval		
Number of Module Packs Adopted	Up to Dec.1974	Up to Oct.1975	Up to Feb.1976
0	54	33	31
1 - 20	27	29	24
21 - 80	17	30	33
> 80	2	8	12
	100	100	100
$\bar{X}$	11.0	23.3	30.3

the data are presented in four intervals, based on the number of modules purchased. These divisions are somewhat arbitrary, but an attempt was made to use intervals corresponding to zero, low, medium and high adoption.

In Table 6.1(a), percentages of schools acquiring module packs in each of three periods of time are outlined. In the first period, from March 1974 to December 1974, individual ASEP units were made available for the first time to schools. By the beginning of 1975, schools had access to all units, and it was assumed that, if the Project had been watched with interest, adoption of materials would have occurred throughout this part of the school year. However after November schools usually begin considering their material needs for the following year so the second time period was arbitrarily set as January to October 1975. The third period, November 1975 to February 1976, was chosen to encompass the period in which orders of ASEP units for the 1976 school year were likely to occur. These three intervals enabled gross measures to be made of the number of schools adopting ASEP module packs over time in the two-year period during which ASEP materials first became available to schools.

Table 6.1(a) shows that 54 percent of all Australian secondary schools acquired no modules in the first period, 27 percent adopted between one and 20 modules, 17 percent adopted between 21 and 80 modules and two percent of schools adopted over 80 module packs. There was a similar distribution in the second period. However, in the third, there was a marked increase in the proportion of schools which did not acquire any module packs.

These figures alone are of limited use for determining the number of schools which had acquired ASEP materials over time and the extent of adoption by individual schools. Other information is required. Table 6.1(b) lists the percentage of schools in each adoption interval at three dates; December 1974, October 1975, and February 1976. Thus, by October 1975, 33 percent of all Australian schools had not yet adopted any module packs, 29 percent had adopted between one and 20 modules, 30 percent had adopted between 21 and 80 modules and about one-tenth of all schools acquired over 80 modules.

Table 6.1(b) shows two important features about the take-up of ASEP module packs. First, there was a general increase in the average adoption of module packs by schools over time. This increase is associated with the decrease in the proportion of schools which had not acquired ASEP modules and the greater proportion of schools in the two higher adoption level categories. Secondly, there was a decrease in the rate at which schools adopted ASEP modules toward the end of the two-year period. By February, 1976 just under one-third of all schools had not yet acquired any ASEP modules. The major reason for the increased average level of adoption between October 1975 and February 1976 was that schools which had already committed themselves to ASEP materials adopted additional module packs during the last interval. This trend was taken to imply that one group of schools continued to buy over time whereas there was a second group which had not bought any ASEP materials almost two years after the first units had been placed on sale.

A comparison of the figures in Tables 6.1(a) and 6.1(b) enables further conclusions to be made about the adoption patterns of schools. Table 6.1(a) shows that, in the period between January and October 1975, 50 percent of schools acquired at least one module pack of ASEP materials. Table 6.1(b) shows that 21 percent of schools adopted modules for the first time in this period. Thus 29 percent of all schools which adopted modules in the first period, up to December 1974, bought again in the January-October 1975 time interval. As 46 percent of all schools acquired modules in 1974 then 17 percent of all schools adopted ASEP module packs in 1974 but not in 1975.

A similar analysis can be made for the second and third time intervals. Table 6.1(a) shows that, between November 1975 and February 1976, 34 percent of all schools bought some ASEP module packs. From Table 6.1(b) a subtraction shows that only two percent bought for the first time. Thus 32 percent of all schools which had purchased modules up to October 1975 chose further ASEP modules in the latter period. As 50 percent of all schools adopted some ASEP modules in the period January to October 1975, then 18 percent bought ASEP modules in the second time interval but not in the third. These patterns are summarised in Figure 6.1.

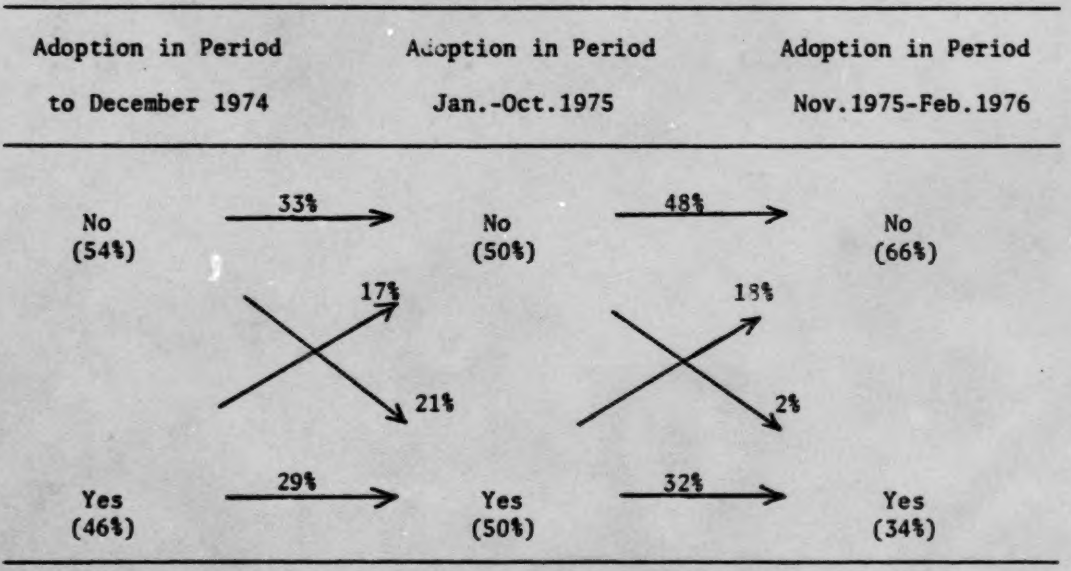
Adoption in Period to December 1974
Adoption in Period Jan.-Oct.1975
Adoption in Period Nov.1975-Feb.1976
No (54%)
33%
No (50%)
48%
No (66%)
17%
21%
18%
2%
Yes (46%)
29%
Yes (50%)
32%
Yes (34%)

Figure 6.1 Patterns of Adoption of ASEP Module Packs: Australia.

Note: Percentages are stated in terms of the total number of schools in all cases.

Several conclusions emerge from this analysis. First, there was a group of approximately 30 percent of secondary schools in Australia which had not adopted any ASEP module packs by February 1976. Secondly, there was a group of schools which acquired ASEP module packs in all three intervals; this group comprised (29/50) x 32 or 19 percent of all schools. Thus about one half of Australian secondary schools adopted ASEP modules in one or two of the three time intervals examined. Thirdly, the similar proportions of adopters and non-adopters in the first two time intervals arose, in part, from a 'swapping over' effect; although 17 percent of schools changed their status from adopters to non-adopters, 21 percent changed in the opposite direction. The swap-over between the second the third periods was not symmetrical, there being a tendency for far more adopters to become non-adopters than was the reverse case. Finally, the smaller proportion of schools adopting ASEP module packs for 1976 implied a general slackening of momentum in national interest for the products of the ASEP development.

Adoption of ASEP Materials in Relation to School Size

The adoption of ASEP modules was an indication of the potential for the use of these materials within the science program in the school. It seemed reasonable to assume that the greater the extent of acquisition, the greater the intent of the school to use the materials. However, when comparing the commitment of schools to the materials, it was first necessary to make a correction for school size. The adoption of 60 module packs by a school where 200 students studied science appeared to be a larger signal of intention to use than a similar adoption by a school buying 60 modules for 1,200 science students. A correction was

Table 6.2 Adjusted Adoption of ASEP Module Packs: Australia (N=300)

6.2(a) Adjusted Adoption Within Each Time Interval

Number of Module Packs Adopted	Percentage of Schools In Each Interval		
	Up to Dec. 1974	In the Period Jan.-Oct. 1975	In the Period Nov. 1975-Feb. 1976
0	54	50	66
1 - 20	28	31	25
21 - 80	16	18	9
> 80	2	2	0
	100	100	100
$\overline{X}$	9.4	11.2	6.8

6.2(b) Adjusted Progressive Adoption

Number of Module Packs Adopted	Percentage of Schools in Each Interval		
	Up to Dec. 1974	Up to Oct. 1975	Up to Feb. 1976
0	54	33	31
1 - 20	28	31	26
21 - 80	16	32	36
> 80	2	4	7
	100	100	100
$\overline{X}$	9. 4	20.5	27.4

Note: Values quoted are adoption of module packs per 500 students studying science.

therefore made to allow for school size. This corrected figure, the 'adjusted adoption', provided a better indication of the extent to which a school had the potential to use ASEP throughout their science courses than did the uncorrected figures.

Adjusted adoption values were obtained by correcting ASEP module pack figures to the same size of school science enrolments, that is, as if all schools had a total enrolment in science in Years 7-10 of 500 students. In Table 6.2 the corrected adoption mean figures are shown for the three time intervals used in Table 6.1.

The adjusted purchase distribution and the mean values of the adoption in each period are similar to the uncorrected figure presented in Table 6.1. This is probably due to the fact that the average number of science students in many secondary schools throughout Australia is close to 500, the arbitrarily chosen denominator.

Under the adjusted purchase figures the rate at which ASEP materials were acquired by the schools could be studied. Rate of acquisition was complicated by the fact that ASEP was not a complete course in its own right, but a set of modular materials from which schools would choose to suit their own program. Rate of acquisition was studied by examining the percentage of schools which had adopted sufficient ASEP materials to service a significant part of a complete science course in Years 7-10. From observations made on school visits before the large-scale data collection, it was decided that this "servicing" could occur if 20 or more module packs for each 500 students had been acquired by a school. By adding the last two columns of Table 6.2(b) an estimate of the rate of adoption was obtained. These figures are graphed as a function of time in Figure 6.2.

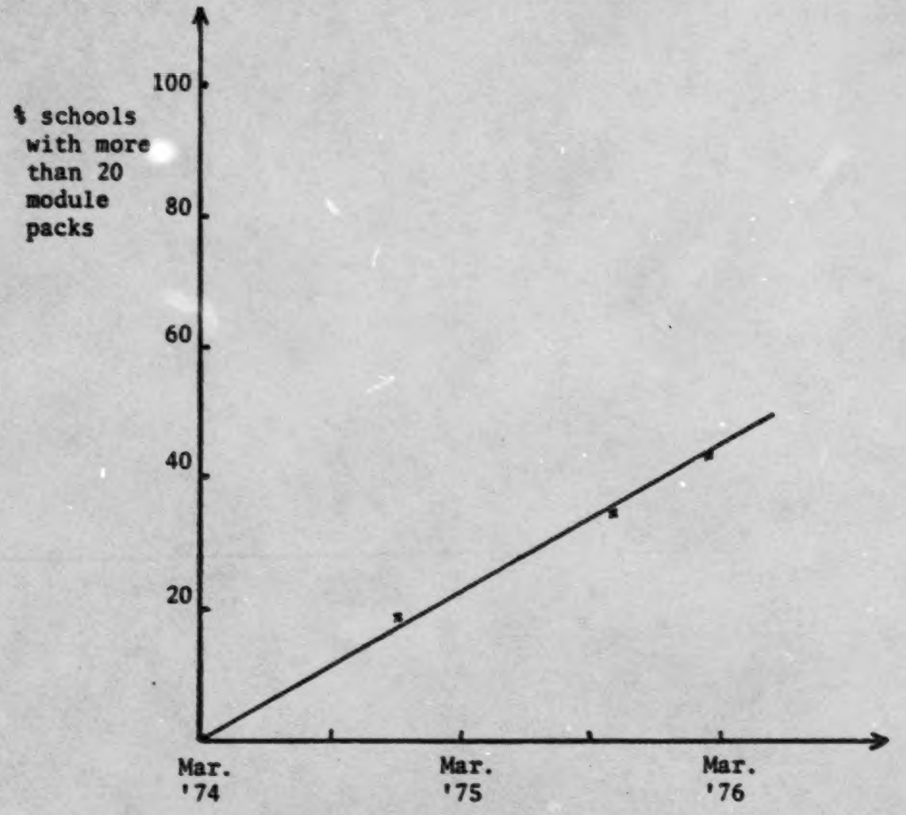

Figure 6.2 School Adoption of ASEP Modules as a Function of Time : Australia

Availability of only four data points made it difficult to explore accurately the shape of the curve for adoption as a function of time. The smooth curve here implies that, for those schools highly committed to ASEP materials, the S-shaped curve of adoption found in other studies did not apply to the adoption of ASEP modules.[1] The S-shaped curve can be explained by invoking a model of social interaction in which change agent to user contacts, and user to user contacts are important means by which knowledge of the innovation spreads through the medium. Information included in Figure 6.2 was taken to suggest that, at the national level, the social interaction model was not adequate to explain the pattern of adoption of ASEP module packs by schools highly committed to these materials. This feature prompted further analyses of adoption patterns in order to explain how users decided to acquire ASEP materials.

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[1] See Rogers and Shoemaker (1971)

Up to this point in the discussion the independent variable used in conjunction with the adoption of ASEP has been time. A second variable of interest is the location of the user, in this case, the school. Study of the spatial distribution of innovations in other disciplines (see for example Hagerstrand, 1965 and 1968) has also been used to investigate the fate of educational innovations. In the United Kingdom (UK) Jenkins (1971) reported that, for Nuffield O-Level Chemistry, accepting schools were clumped together generally in the vicinity of a city where a 'master teacher' for the project was located. In the United States of America (USA) House (1974) showed that the take-up of the Illinois Gifted Program tended to spread along major roads in the State. The availability, to potential adopters, of first hand information about the innovation led to promulgation in these cases. In an overview of the factors affecting the flow and utilisation of new knowledge Havelock (1973a) identified one major element as proximity. He concluded that:

> ... proximity to various resource systems is important for users. However, the proximity of users to one another is also important because it increases the likelihood that users will be aware of common interests and needs, and will pool their internal resources. It also increases the likelihood that innovators in the user system will be in contact with opinion leaders, and that opinion leaders will be in contact with everybody else.
>
> (Havelock, 1973a: 11-29)

This concept of proximity was taken as the basis for examining the breakdown of the distribution of ASEP materials as a function of the location of schools.

Metropolitan - Non-Metropolitan Differences

The first analysis was guided by a knowledge of the distribution of population and of schools within the country. The concentration of people in cities coupled with the large distances between settlements in most country regions in Australia suggested that one variable which could influence the adoption of ASEP was the location of the school. Now all ASEP materials were distributed from the one source, the Victorian Stores Branch. However, the availability of educational resources in the Australian educational systems has traditionally been centred in the capital cities. This factor, and Havelock's proposition of the importance of teacher to teacher links, implied that there may have been differences in the extent to which schools in metropolitan areas adopted ASEP material compared with non-metropolitan schools.

Table 6.3 sets out the details of adoption of ASEP module packs by metropolitan and non-metropolitan schools in the three time intervals; up to December 1974, January to October 1975, and November to February, 1976, are presented. In all cases means and standard deviations are given of adoption, corrected for school size. The information in Table 6.3 shows that there were large variations in adoption within both the group of metropolitan schools and within the groups of non-metropolitan schools. This is indicated by the size of the standard deviations in relation to the means.

Table 6.3 Differences in Adoption of ASEP Module Packs Between Metropolitan and Non-Metropolitan Schools. Australia.

	Metropolitan Schools (N=182)		Non-Metrop. Schools (N=118)	
	$\bar{X}$	SD	$\bar{X}$	SD
Modules Adopted in 1974	9.6	16	9.1	16
Modules Adopted in 1975	13	27	9.2	17
Modules Adopted in 1976	7.5	18	4.0	10
Total Modules Adopted up to October 1975	22	32	18	28
Total Modules Adopted up to February 1976	30	43	22	34

No significant differences in levels of adoption between the two groups of schools could be obtained from the data available and consequently it was assumed that, at the national level, there were no differences in the extent of adoption between metropolitan and non-metropolitan schools.

Between-State Differences

The findings in the previous section prompted an examination of the breakdown of adoption of ASEP module packs by State. As indicated in chapters One and Two, State Governments have traditionally been responsible for the administration of education in Australia. This has affected the types of curricula offered in schools. Within subjects it has affected their organisation and the use of curriculum resources such as textbooks. There was therefore an a priori case for examining variations in adoption of ASEP materials between States.

Table 6.4 Average Number of ASEP Module Packs Adopted by Schools Within States. 1974 - 1976

	ACT	NSW	VIC	QLD	SA	WA	TAS
	(N=18)	(42)	(43)	(48)	(42)	(34)	(33)
Adoption to December 1974	11	6.8	12	2.6	18	0.2	39
Adoption in the Period Jan.-Oct. 1975	16	8.0	12	5.4	28	4.1	23
Adoption in the Period Nov.1975 - Feb.1976	8.0	4.5	3.5	4.1	23	3.4	8.0
Total to Feb. 1976	36	19	28	12	70	7.7	71

Note: Adoption is corrected for school size.

Table 6.4 shows wide variations between States in the total adoption to February 1976 and also large variations over time. As an aid to the study of adoption patterns, analyses of variance techniques were applied to the State level data in order to investigate features of between-State differences. Following the procedures outlined by Lewis (1976) two approaches were used initially to examine the extent to which schools in each State had similar adoption patterns. The first was to calculate an F ratio to determine whether State was a significant factor in explaining variations in adoption between schools. The F ratio was calculated using a one-way analysis in which adoption by schools of ASEP module packs was the independent variable. The results in Table 6.5 show that the F ratio was significant at better than p=0.001 on all four measures.

Table 6.5 Between and Within-State Variations in Adoption of ASEP Module Packs by Schools

Variance	Significance Level	Eta-squared
Adoption to December 1975	< 0.001	0.19
Adoption in the Period Jan.-Oct. 1975	< 0.001	0.19
Adoption in the Period Nov.1975-Feb.1976	< 0.001	0.25
Total Adoption to Feb.1976	< 0.001	0.21

Note: Eta-squared is the ratio of the sum of squared deviations of State means from the grand mean to the total sum of squared deviations.

Table 6.5 also contains the values of the ratio of the sum of squared deviations of State means from the grand mean to the total sum of squared deviations; that is, the proportion of total sums of squared deviations due to between-State difference. This value, eta-squared (Kerlinger, 1964), provides an indication of the similarities in adoption patterns within States. These values varied from 19 percent, in January-October 1975, to 21 percent for sales over the three-year period under review. If these statistics are accepted then they show that significant differences between States existed in all four intervals and that the extent of significance was similar in each interval.

An analysis of variance was also carried out in conjunction with a test to determine significant differences in means between the groups (in this case, States). A multiple range test attributed to Scheffe (1959) was used to discover differences. This is a particularly stringent test of difference and Scheffe has suggested that it is appropriate to establish a liberal significance level. In this case a ten percent level was set. Figure 6.3 displays the groups of States in homogeneous subsets of means, for all four independent variables.[2]

When Table 6.4 is examined in conjunction with Figure 6.3 certain generalisations about the adoption patterns in the States can be made. In all States except Tasmania (TAS) the highest level of adoption occurred during 1975, the year when the complete set of ASEP units was first available. High early ownership in Tasmania can, in part, be explained by the distribution of ASEP units to all government schools free of charge. During 1974, a decision was taken by the Director General of Education, after advice from the Superintendent of the Mathematics and Service Resource Centre, to allow secondary science teachers to order module and inspection packs (Fish, 1976). Schools took delivery of these packs as they became available; larger schools

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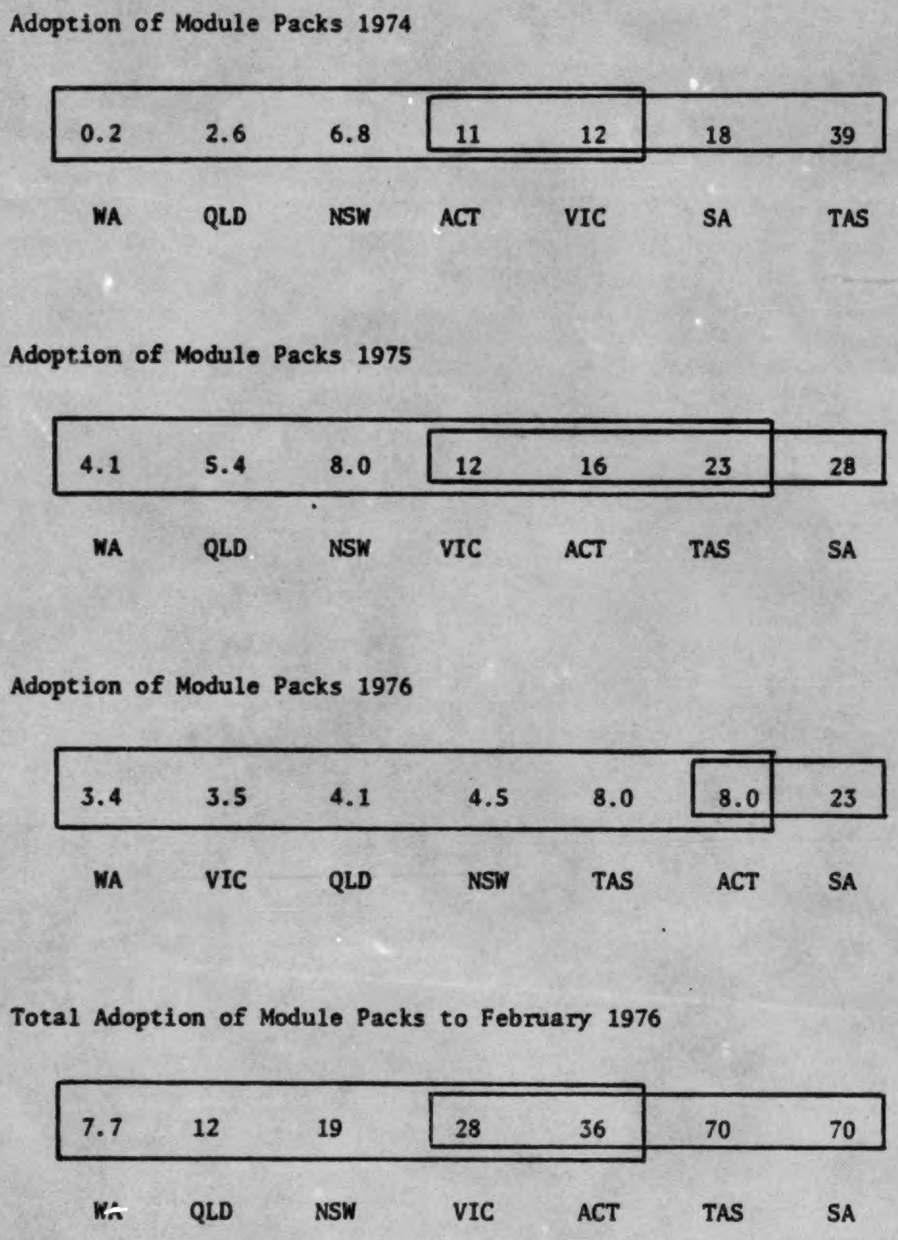
[2] The Scheffe test uses a single range value for all comparisons which is appropriate for considering all possible linear combinations of the group means. It is therefore a very conservative test. Scheffe (1959:275) suggests that a suitable method for making multiple comparisons is to use Scheffe procedures with a significance of 0.10. This is the procedure used throughout this study.



Adoption of Module Packs 1974

0.2
2.6
6.8
11
12
18
39
WA
QLD
NSW
ACT
VIC
SA
TAS

Adoption of Module Packs 1975

4.1
5.4
8.0
12
16
23
28
WA
QLD
NSW
VIC
ACT
TAS
SA

Adoption of Module Packs 1976

3.4
3.5
4.1
4.5
8.0
8.0
23
WA
VIC
QLD
NSW
TAS
ACT
SA

Total Adoption of Module Packs to February 1976

7.7
12
19
28
36
70
70
WA
QLD
NSW
VIC
ACT
TAS
SA

Figure 6.3 Homogeneous Sub-Sets of State Means of Adoption of ASEP Module Packs: 1974 - 1976

Note: Purchases are corrected figures.

received 48 module packs, and smaller schools 24 or 12 module packs. Teachers in the smaller schools were encouraged to exchange materials where this was possible, so that maximum use could be made of these resources. Continued interest in the use of ASEP materials in Tasmania was indicated by the high levels of adoption of ASEP units in 1975, when government schools themselves were responsible for purchasing any further supplies of ASEP materials. Tasmania was the only State where ASEP materials were distributed without charge to schools.

The other State where the average level of adoption was relatively high was South Australia (SA). An important feature of the pattern in this State was the increase in levels of acquisition from 1974 to 1975, and then a continuing high level of adoption into 1976. This was the only State where a large percentage slump in adoption between 1975 and 1976 did not occur. By February 1976, the average level of ownership of ASEP module packs by schools in South Australia just exceeded the Tasmania figure.

Figure 6.3 also shows that, on average, schools in Victoria (VIC), the Australian Capital Territory (ACT) and New South Wales (NSW) were 'medium' adopters of ASEP module packs. These States tended to straddle the homogeneous subsets. In all these States there was a large reduction in average adoption from 1975 to 1976.

Schools in Queensland (QLD) and Western Australia (WA) were, on average, the lowest adopters. In general, few ASEP materials were bought in Queensland and Western Australia in 1974 and there was a small increase in the next two intervals.

In summary, there were significant between-State differences in the average extent of adoption of ASEP materials by schools. The analyses identified three groups of States using school adoption as the criterion. High ownership of ASEP module packs occurred more in schools in Tasmania and South Australia than in other States. There was a greater proportion of schools in Queensland and Western Australia which had not purchased ASEP modules than in the other States. The situation in the Australian Capital Territory, New South Wales and Victoria was between these two extremes.

Choice of Units by Schools

The study of the national impact of ASEP has so far focussed on the adoption of ASEP materials by schools without reference to the characteristics of the 47 units which made up the set. An independent source of data, the records of the distributor, the Victorian Government Stores Branch, enabled an analysis of the patterns of sales of ASEP units to be undertaken. This was important because it provided a basis for understanding the grounds on which teachers selected units and how they planned their courses which included ASEP materials as resources.

It was considered to be of interest to determine which units were adopted to a greater extent than others, and from this to draw conclusions about those units which were preferred by science teachers.

Three factors were considered in relation to popularity. The first was the subject matter included in each unit. It was conjectured that teachers of science may prefer to select and use units based on the subject area in which they had been trained rather than to select units related to other content areas. Data on the academic content of teachers' tertiary courses were therefore collected on the Teacher Questionnaire and is included in Table 6.6.

A second factor which might influence unit popularity was time of release of the units. The first ASEP unit, 'Forces', was released in February 1974. The remainder were made available to schools over a period of 12 months and the last unit, 'Petroleum', was published in January 1975.

It was shown in Table 6.1 that a high degree of adoption took place in 1974 when only some of the ASEP units were available. It was of interest to see whether units which were tried at an early stage continued to be popular over time, and to compare the purchase of these units with those released later. A division between 'early' and 'late' publication dates was made by labelling the months February 1974 to July 1974 as 'early' and the months August 1974 to January 1975 as 'late'.

Finally, it was also expected that the examination of the popularity of units between Stages would provide additional data for determining how teachers planned to introduce ASEP into their courses. The ASEP units were classified as belonging to one of three Stages. State One units were those designed to be used by most students in the first year of secondary school. Stage Two units were those suitable for students in the second and third years and Stage Three units were those suitable for students in the third and fourth years of secondary school. The allocation of units to categories of subject matter, time of publication and Stage level was carried out with the cooperation of five experienced science teachers. The classifications are presented in appendix 6/1. There was no 'early' category for Stage Three units because the earliest date of publication was August 1974.

The extent of adoption of ASEP units according to these criteria is shown in appendix 6/2. At all Stage levels there was a marked preference for units with titles which implied they contained subject matter in the physical or biological sciences. This suggested that teachers tended to select units which covered content material with which they were familiar. They appeared not to want to use ASEP units which contained work they had not taught before.

The relative unpopularity of cross-disciplinary units may be interpreted to indicate that a large-scale shift in teaching emphasis, from "science" as one of the constituent disciplines, to an "integrated" form had not occurred in many Australian secondary schools prior to the production of the ASEP materials. Also, it appeared that the ASEP materials were having a small effect, at least up to 1976, in reducing the extent to which courses in science were based on traditional science subjects (Bernstein, 1972).

Within Stages One and Two, for both physical/biological units and cross-disciplinary/earth science groups, units which had been released before July 1974 were more popular (in terms of sales) than those released after that date. Also, there was a trend for these more popular units to have a higher rate of adoption than those lower on the tables. This was interpreted as suggesting that units which were 'visible' in the early period of high adoption remained popular in schools which acquired more ASEP materials over time. It may have been the case that the reaction to these units in the schools during 1974 influenced others who adopted ASEP for the first time in 1975 and 1976.

In order to examine the popularity of units within Stages average sales of ASEP module packs within each Stage were calculated at six dates, from January 1975 to February 1977. The results are recorded in Table 6.7.

Table 6.7 Average Sales of ASEP Module Packs: By Stage

	Average Sales of Module Packs (Hundreds)					
Stage Level	Jan.'75	June'75	Dec.'75	May'76	Oct.'76	Feb.'77
One	7.0	11.0	14.1	16.6	17.6	20.0
Two	5.6	8.2	10.8	13.1	13.9	15.6
Three	3.9	6.4	8.2	10.5	11.2	12.4

Note: Units became available to schools from March, 1974.

Stage One units were more popular than units in the other two Stage Levels, and the rate of increase of sales of Stage One units was greater than for the other two Levels. This implied that a general method of adoption of ASEP materials by schools was to introduce ASEP units to the most junior classes in the secondary school. As more schools first adopted ASEP materials in 1975 and 1976, they generally chose Stage One units and this kept the rate of increase of Stage One sales at a relatively high level.

Within Stages the rate of adoption was examined. Approximately equal numbers of module packs were adopted during each of the first two years of availability of ASEP materials. In Stage One and Stage Two 35 percent of the total sales to February 1977 occurred in these two intervals. For Stage Three the corresponding figures were 31 and 35 percent respectively. This indicated that Stage Three units were adopted to a greater extent during the second year of availability, a further indication that schools tended to introduce ASEP to a school by first adopting Stage One units and following up by choosing units in the higher Stages.

During 1976 the general rate of adoption diminished, but an encouraging sign for the continued influence of ASEP occurred at the end of the data gathering period in early 1977 when a small upturn in the rate of sales at all stages was evident. This may have been due to ordering for the 1977 school year. However, no similar increase was evident at the beginning of 1975 or 1976. The pattern for 1977 may indicate that continued buying throughout the year has been reduced after the initial interest in ASEP had subsided and that most adoption is now confined to the end of year periods when schools usually order textual materials for the next school year.

Adoption and Use of ASEP Materials

Major sources of information in the survey stage of this study were the teachers of science who provided data on the extent of use of ASEP materials in schools. At each of the year levels 7-10 teachers of science were asked in 1975 about their use of a range of science curriculum materials and textbooks including ASEP materials. The materials and textbooks had been identified in other surveys as being popular in one or more States of Australia (Dale, 1975; Beeson and Gunstone, 1975).

To obtain a school measure of use of each of these materials, responses on the Teacher Questionnaire were coded in the following manner:

(1) Used, the equivalent of one term or more (1.5);

(2) Used, but less than a term (0.5);

(3) Not used (0.0).

The coding values were chosen after examining a sample of questionnaire returns from Victorian schools where the use of ASEP and other tests in 1975 was known. It was considered that the value of the total reported use of a text taken from the questionnaire responses would more accurately reflect the true value at each year level if a coding of 1.5 was applied to the highest category rather than any other alternative.

Use in this context meant that the text or curriculum materials were the major source from which the teaching of science was derived. The measurement of the use of ASEP materials was important at a later stage in the identification of schools for further study, and this was the major reason for attempting to obtain a value for it from a questionnaire. It was recognised that, standing alone, the measures of use provided little information of value to the study of the implementation of ASEP except that it was additional measure to that of adoption or the commitment of schools to the ASEP materials.

For each school the extent of total use of ASEP materials by science teachers in 1975 was estimated by aggregating the responses of the staff involved at each year level.[3] Thus, for each school, there were four measures of the use of ASEP in 1975, one for each of the year levels 7-10.[4] The aggregation procedure added a degree of robustness to the measure of use which would not have been obtained from a single estimate by a Head of Science. The results are listed in Table 6.8. In addition a set of values for Australia was obtained using the weighting procedure outlined in appendix 5/7.

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[3] The SPSS program AGGREGATE was used to sum these responses.

[4] In three States; Queensland, South Australia and Western Australia, there are only three year levels, 8-10, in the junior secondary school.

Table 6.8 Mean School Use of ASEP, 1975: By State

	ACT	NSW	VIC	QLD	SA	WA	TAS	AUST
Year	(18)	(42)	(43)	(48)	(42)	(34)	(33)	(301)
7	0.55	0.45	0.71	-	-	-	0.78	0.57
8	0.45	0.41	0.75	0.23	0.70	0.14	0.79	0.49
9	0.42	0.40	0.66	0.23	0.70	0.10	0.75	0.46
10	0.31	0.41	0.42	0.08	0.69	0.05	0.53	0.37

Note: Unit is effective number of terms.

A number of conclusions can be drawn from Table 6.8. First, there were variations in use between States, and these were consistent with the levels of adoption of ASEP reported earlier. The highest average use of ASEP was by schools in Tasmania and South Australia and the lowest average use was by schools in Queensland and Western Australia. The other States fell between these extremes. The data also reinforce the conclusion advanced earlier in the chapter; that there was a general tendency for schools to use more ASEP materials in the lower year levels than in the higher years of the junior secondary school.

It should be noted that these figures include those schools where no use at all was made of ASEP in 1975; an estimate of average use which considered only schools which had adopted ASEP module packs up to October 1975 would have, of course, been somewhat higher.

To examine the relationship between adoption and reported use across States an estimate was made of the relative time spent by teachers using ASEP in 1975. Two factors were considered in order to transform use as measured in number of terms to use as measured in time. The first was the extent to which teachers were involved with more than one class grouping of science at each year level. However, it was assumed that the extent of multiple class teaching in science by staff in each State was similar and thus this factor was assumed to be constant with no influence on the between-State comparisons.

The second factor was the amount of time devoted by schools to the study of science at each year level 7-10. These figures are reported in Table 6.9. For each State the estimate of relative time spent using ASEP by schools in 1975 was found by multiplying the mean school use of ASEP by the mean number of hours per week of science teaching at each year level, and summing the results across Years 7-10. These values are listed in Table 6.10 and plotted in Figure 6.4.

Table 6.9 Time Spent per Week by Schools on Science Instruction: 1975 By State

Year	ACT	NSW	VIC	QLD	SA	WA	TAS
7	3.5	3.4	2.4	-	-	-	3.4
8	3.4	3.4	2.4	3.3	3.3	3.9	3.4
9	3.5	3.4	2.6	3.6	3.6	3.9	3.5
10	3.7	3.7	2.9	3.6	3.9	4.0	3.6
Total	14.1	13.9	10.3	10.5	10.8	11.8	13.9
SD	1.8	1.1	2.2	1.3	1.2	0.7	3.1

Note: Units in hours.

Table 6.10 Relative Mean Time Spent Using ASEP and Extent of Adoption 1975 : By State

	ACT	NSW	VIC	QLD	SA	WA	TAS
Relative Time Spent[a]	6.07	5.80	6.44	1.87	7.52	1.13	9.89
Adoption to October 1975[b]	28.6	14.8	24.7	8.0	46.2	4.4	63.2

Note: a: Arbitrary units.

b: Extent of adoption figures are corrected for school size.

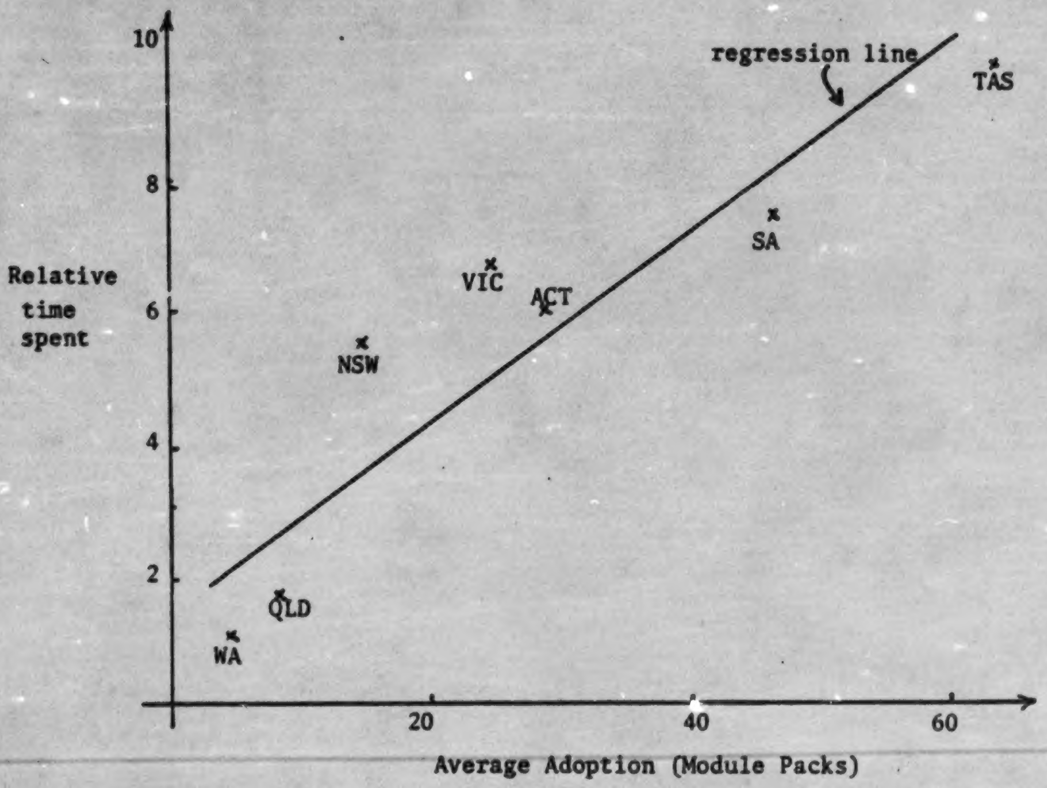

Figure 6.4 Relative Mean Time Spent Using ASEP Materials Versus Mean Adoption of ASEP Module Packs: 1975

The plotted points reveal a linear relationship between mean adoption and reported use across States. The figure indicates that the possession of greater amounts of ASEP module packs is associated with higher use of ASEP materials in schools.

The situation in Tasmania was of particular interest as it was the only State where decisions regarding the acquisition of ASEP by schools were made at the system rather than the school level.[5] It might have been expected that non-participation by teachers in the decision to supply ASEP units to schools would have led to their wide scale rejection as learning materials. This was not the case as Figure 6.4 shows.

Summary

The analysis of responses from teachers in charge of science in schools, coupled with information collected from the Victorian Government Stores Branch records, enabled the extent of adoption and use of ASEP materials to be charted. Up to February 1976, approximately 70 percent of Australian secondary schools had obtained some of the ASEP units. The amount purchased varied markedly between schools in each State, and there were large variations in the average number of ASEP packs bought by schools between the States. The data also showed a decline in the number of schools buying units for the first time in 1976. The relatively steady purchase of module packs during 1976 and into 1977 was interpreted to suggest that most of the materials were purchased by schools already committed to the use of ASEP.

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[5] This applied to government schools only. Schools were given choice as to which units they would acquire.

An examination of the sales of individual units showed that those of Stage One were the most favoured. At all stage levels there was a tendency for units with titles describing content areas belonging to the traditional subject disciplines to be more popular than other units. The date of release of a unit appeared to be related to the sales of Stage One and Two units, which were published over a period of months. Stage Three units were released over a shorter period of time, and date of release was not related to extent of sales.

A measure of the use of ASEP materials showed that, between States, use was highly correlated to extent of purchase. Thus, it appeared that, on average, schools purchasing units put them to use to about the same extent in each State.

CHAPTER SEVEN

A COMPARISON OF SUPPORT FOR ASEP THROUGH SYSTEM LEVEL STRATEGIES

The Choice of Systems for Study

In chapter Six it was shown that there were differences in the average level of adoption and use of ASEP materials between States. It is not surprising that differences were found since it has been traditional for education in Australia to be administered by State authorities. Consequently, there have always been differences between the States in such matters as the control of syllabuses, examinations and even student retentivity (Rosier, 1978).

From the results presented in the previous chapter it can be seen that, in terms of the extent of commitment of schools to ASEP, the six States may be considered to form three groups. In Tasmania and South Australia penetration of ASEP materials was high. In Queensland and Western Australia the penetration of ASEP was low. New South Wales and Victoria, where there was moderate penetration, fell between these groups.[1]

This chapter is devoted to an examination of system level or medium effects in order to explain variations in the penetration of ASEP materials in different States. Rather than attempt to describe and contrast the situation in every State three States, in which there were large differences in the average level of penetration of ASEP materials, were chosen for close scrutiny. The States were:

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[1] Education in the Australian Capital Territory (ACT) is administered by the Federal Government. The emphasis in the discussion of system level or medium effects here is on the role of State systems. Although data was collected in the survey phase of the study from the ACT, no further information was sought from the ACT.

(1) South Australia, where the impact of the ASEP material was relatively high;

(2) Queensland, where the impact of ASEP was relatively low; and

(3) Victoria, where there was an average level of adoption.

The selection of a particular State from each group was made after a consideration of what was known about the control of school curricula by system level factors. In general, the State chosen was the one in which decision making about the science curriculum by schools was subject to few directions by external sources. In these circumstances it was expected that ASEP ideas and materials would be on an equal footing with other curriculum resources when teachers were considering the construction of their science programs.

Queensland was chosen in preference to Western Australia because of the greater overt influence of competing materials in the latter State. Data collected by the survey from schools in Western Australia showed that extensive use was made there of curriculum materials produced by the Western Australian Education Department (appendix 7/1). High use of these materials was associated with three factors. First, they had provided a structural basis for teaching science during a period when there had been shortages of qualified secondary school science teachers. Secondly, the content of courses, which were tested in comparability examinations administered by the Western Australian Board of Secondary Education, was covered by the materials. Thirdly, the materials were provided free to all schools. Under these conditions it seemed improbable that many schools would consider the ASEP materials at all. A similar set of materials had not been provided in Queensland where a greater range of textual materials was used in science (appendix 7/2).

South Australia was chosen for study rather than Tasmania for a different reason. This was, however, again related to user choice. As indicated earlier, Tasmanian secondary schools were provided with ASEP materials free of cost during 1974. Schools received individual units as they became available. This accounted, in part, for the widespread adoption of these materials by schools (appendix 7/3). ASEP units were also widely used in South Australia (appendix 7/4) but here it was the decision by the users in schools which led to the adoption of these materials.

Victoria was chosen over New South Wales for several reasons. The first was associated with the length of time schools had been encouraged to exercise autonomy in curriculum decisions. In New South Wales schools became formally responsible for their own curriculum development for science in 1975, but Victorian schools had exercised this responsibility since 1967. It was considered worthwhile to examine the ways in which Victorian schools and the educational medium in that State reacted to ASEP because conditions which appeared to foster school-based curriculum development, had existed for a long period of time. The second reason was linked with the fact that the ASEP development team had been housed in Melbourne, the capital city of Victoria, and consequently strong links had developed between some schools and the ASEP team during the formative stages. The fact that the Victorian Education Department had supported ASEP strongly in its initial stages provided a third reason for choosing Victoria rather than New South Wales. The use of ASEP in these two States is outlined in appendices 7/5 and 7/6. ASEP was used to a greater extent by Victorian teachers than by their New South Wales counterparts.

As outlined in chapter Five information was collected in the States in a variety of ways, from a range of sources. These investigations were structured around two major themes of the paradigm represented by Figure 4.2 in chapter Four. There, a distinction was made between:

(1) the strategies of the educational medium designed to support the adoption and implementation of the ASEP ideas and materials; and

(2) the factors which shaped these strategies. The strategies adopted were considered to be dependent on the complex interrelationships of historical, political and administrative forces comprising the educational milieu into which the innovation was projected. The extent to which certain key strategies were employed in each State is presented on a comparative basis in this chapter. Subsequently, in chapter Eight, each State is considered separately when describing the factors which affected the extent to which the key strategies were used to support the ASEP development.

The Impact of ASEP in the Three States

In the previous chapter data were presented on the extent of adoption and use of ASEP in all Australian States. From these analyses a set of measures was assembled which summarised the impact of ASEP materials in the three States chosen for comparative analysis. These appear in Table 7.1 and show that there were differences between the States in the percentage of schools which had adopted ASEP materials and in the average level of adoption. There were also variations in the adoption of ASEP materials

Table 7.1 Criterion Set of Measures of the Impact of ASEP in Three States

	Victoria (N=43)	Queensland (N=48)	South Australia (N=42)
Average school purchase of module packs[1]			
to December 1974	12	3	18
January-October 1975	12	5	28
November 1975-February 1976	3	4	23
Percentage of schools with at least one module pack			
up to December 1974	63	23	57
up to October 1975	81	40	88
up to February 1976	84	44	88
% of schools in October 1975 with			
0 module packs	19	60	12
1-19 module packs	22	19	10
20-80 module packs	54	19	64
> 80 module packs	5	2	14

[1] Corrected for school size. Values are per 500 science students.

from year to year. An examination of these data led to the following conclusions about the impact of ASEP in the States under review:

VICTORIA Most schools adopted ASEP module packs and of these the majority first purchased in 1974, the year the ASEP materials became available. However, most schools did not adopt sufficient module packs to conduct a complete course using ASEP, as only five percent of schools bought 80 module packs or more by October 1975. From that date interest in the materials waned. Only three percent of schools bought for the first time and those schools which had already purchased greatly reduced their intake of ASEP units.

QUEENSLAND Commitment to ASEP, both in the extent of adoption and in the proportion of schools owning any ASEP materials, was low. Only 21 percent of schools adopted 20 module packs or more by October 1975.

SOUTH AUSTRALIA Interest in ASEP built up over the first two years of its availability and by October 1975 nearly 90 percent of schools had adopted ASEP modules. Although no further schools adopted ASEP in 1976 there were continued high purchases in that year. The generally high level of adoption was reflected in the fact that 78 percent of schools had bought twenty modules or more up to October 1975.

Strategies of the Educational Medium

It was suggested in chapter Four that the adoption and maintenance of an innovation in schools was related to several key strategies. These were identified as:

(1) journal articles, particularly those in 'local' publications;

(2) teacher education courses;

(3) user participation in the formative stages of the innovation; and

(4) contact with change agents.

This summary of strategies formed the basis for data collection. Information was obtained from Heads of Science Departments in schools about participation in the formative stages of ASEP. All teachers provided data relating to teacher education and contact with change agents. An analysis of science teachers' journals was carried out to seek evidence of the role of these journals in providing information about ASEP to teachers. Each of these strategies is now considered.

Journal Articles

In Australia there are science teachers' associations in each of the States and Territories which jointly constitute the Australian Science Teachers' Association (ASTA). However, up to now, the federal association has had little real power and the major responsibility for professional matters relating to science teaching rests with the constituent State associations.

The dispersed location of schools within even the smaller States makes the State science teachers' journal an important means of communication about trends in science teaching. In these journals important local issues, such as the conduct of science courses in the context of State level administration and the availability of resources, are often discussed.

The influence of these journals is dependent, in part, on the number of teachers reached and on the regularity of publication. Membership of the State Association includes a subscription to the journal.

There are no recent data available on the proportion of all science teachers in secondary schools who are members of State science teachers' associations. The only reliable figures are those of Rosier (1973) who reported that the percentages of all teachers of the sciences who were members of a professional subject-matter teachers' association in 1970 were as follows: 37 percent in Victoria,[2] 41 percent in South Australia, and 48 percent in Queensland. Thus, if these values were applicable during the period under review, between four and five teachers of science in every ten received journals produced by the State associations.

The second determinant of influence is the regularity of the journal. For the purpose of the present investigation interest was centred on the regularity of 'Lab. Talk' in Victoria, 'SASTA Journal' in South Australia and 'The Queensland Science Teacher' in Queensland during the interval from 1970 to 1975. This was the period when ASEP materials were developed and when the ASEP materials were being implemented in schools. 'Lab. Talk' was published 11 times each year from 1970 to 1973 and six times annually from 1974. 'SASTA Journal' was produced four times a year in the period 1970-1975. This was also the rate of publication of 'The Queensland Science Teacher' but, due to financial difficulties, the Queensland Science Teachers' Association was forced to cease production of the State journal in 1973 and 1974.

In order to gauge the extent to which the ASEP Project was publicised a count was made of the articles devoted to ASEP in these journals in the period from 1970 to February 1976. There were 24 articles in 'Lab. Talk', nine articles in 'SASTA Journal' and three in 'The Queensland Science Teacher'. Prima facie, the results of this investigation suggest that there were large between-State differences in the degree to which ASEP was brought to the attention of science teachers by State level science teacher association publications. Teachers of science in Victoria appeared to be in a position to follow trends in the development and use of ASEP more closely than science teachers in the other two States. In Queensland the findings imply that the local journal was a limited resource for teachers contemplating the adoption of ASEP materials into their programs.

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[2] The Science Teachers' Association of Victoria also welcomes 'school memberships'. Hence the number of teachers who had direct access to its publications is probably under-estimated by this figure.

It should also be noted that all members of State associations receive 'The Australian Science Teachers' Journal' (ASTJ). However, because it is a national journal, ASTJ tends to focus on general topics rather than on immediate issues of direct concern to local science teaching. It is concluded here that State level journals had great potential to spread information of immediate relevance to the adoption and use of ASEP in science programs and that there were differences between the States in the influence these journals had in promoting ASEP.

Teacher Education Courses

Knowledge of the rationale and content of a new curriculum can be acquired by potential users through formal courses. Information collected on the Teacher Questionnaire enabled between-State comparisons of the extent to which teachers undertook courses devoted to the study of the ASEP development.

First, inservice courses for practising teachers during 1974 and 1975 are considered. This was the period when ASEP materials became generally available to schools and when State authorities assumed responsibility for supporting the ASEP materials and their implementation in schools. Table 7.2 shows the degree of teacher attendance at relevant inservice activities in 1974-1975.

Table 7.2 Percentage of Teachers Versus Days Spent at ASEP Inservice Courses: 1974-1975. Teacher Responses: By State

Number of Days		Victoria (N=234)	Queensland (N=329)	South Australia (N=288)
Four or more	(5)	2	4	4
Three	(4)	2	2	2
Two	(3)	7	4	3
One	(2)	20	6	6
Zero	(1)	69	84	85
		100	100	100
Mean Number of Days		1.47	1.36	1.34
Standard Deviation		0.89	0.93	0.96

In all three States the majority of science teachers reported that they had never attended an inservice course devoted to the ASEP development. This may have been due to lack of interest in ASEP on the part of these potential users but, given the general level of excitement amongst teachers about the materials and their rate of adoption in 1974 (Owen, 1978) this is an unlikely reason for non-attendance. The other possibility is that suitable courses on a large scale, designed to reach the mass of science teachers, were not conducted. Only in Victoria, where 20 percent of teachers attended a one-day inservice program, was there an attempt on behalf of State level authorities to reach a high proportion of potential users. A few teachers in each State went to inservice courses of longer duration. The small proportion in this category implies that longer courses were organised at a local rather than State-wide level.

Differences between States in the extent of ASEP inservice courses were investigated using the data assembled in Table 7.2. By assigning values to the number of days attended by teachers means and standard deviations were calculated. The analyses revealed no difference (at the one percent level) between States. It was inferred that there were no differences between the States in the attendance and impact of inservice activities related to ASEP.

A second aspect of teacher education which was investigated was the emphasis on ASEP in pre-service courses. Compared with their peers in other countries, teachers of the sciences in Australia are relatively young. Rosier (1973) showed that, in 1970, 50 percent of science teachers in Australia were 27 years or younger. This contrasts with figures in other countries; 28 percent in the United States of America, 32 percent in Great Britain and 16 percent in Sweden for the same age group (Comber and Keeves, 1973). Data collected in this study, and recorded in appendix 7/7, show that, at the end of 1975, the situation in Australia had not changed markedly. There was a small proportion of science teachers over 40 years of age but the majority were under 30. From the distribution of ages, it was clear that a substantial number of science teachers in each State had undertaken some pre-service education in the period 1970-1974 when the ASEP Project was in the development stage.

In Australia the training of secondary school teachers has traditionally been divided into two components. One is devoted to the study of academic subjects related to a subject discipline, or disciplines.

The second is concerned with professional education. For prospective science teachers it might be expected that in this second part they would be made aware of such factors as: the place of science in the total curriculum, the characteristics of textual materials available, and the educational rationale underlying the recent development projects in science. It was therefore expected that teachers in training in the period just prior to and during the first release of the ASEP materials would have been made aware of their characteristics.

Information about the extent to which ASEP had been included as part of the pre-service education of prospective science teachers was collected by means of the Teacher Questionnaire. Staff of science departments in schools who commenced teaching in 1973, 1974 or 1975 were asked to indicate their perception of the relative importance placed on ASEP materials in their course of teacher training.

Table 7.3 shows that variations existed within States. For example, in Victoria 19 percent of science teachers in training responded that ASEP was given more prominence in their 'method' courses than other curriculum materials. Forty-eight percent reported that, although ASEP was discussed, it was given no more prominence than other science curriculum materials. There was a smaller proportion, 13 percent, of replies which indicated that, although science curriculum materials were considered, ASEP was not included. Nineteen percent stated that they had not discussed science curriculum materials at all during their period of pre-service education.

As indicated above some teachers in all States reported that they undertook courses in which, although science curriculum materials were discussed, ASEP was not included. These were intriguing findings,

Table 7.3 Percentage of Teachers Versus Emphasis on ASEP in Pre-Service Education: By State

Emphasis on ASEP	Victoria (N=89)	Queensland (N=129)	South Australia (N=128)
A range of curriculum materials discussed, but ASEP given more prominence (4)	19	33	17
A range of curriculum materials discussed, but ASEP not given special prominence (3)	48	36	30
A range of curriculum materials discussed, but ASEP was not among them (2)	13	15	9
There was no specific discussion of curriculum materials for science in my teacher training (1)	20	16	44
	100	100	100
Mean level of emphasis on ASEP	2.65	2.86	2.19
Standard deviation	1.00	1.05	1.22

Item: To what extent did your University or College classes in your preparation to be a science teacher refer to ASEP materials?

particularly in view of the widespread interest about the ASEP development among science educators in colleges and universities in the early and mid-1970's. Given this it seems unlikely that discussion of ASEP would not have been included in 'method' courses which examined science curriculum materials during this period. One explanation which can be advanced for the nature of these responses is that they were from teachers who commenced work in schools in 1973 and had passed through teacher training institutions before discussion and analysis of ASEP had been incorporated into college and university 'method' programs.

Some teachers in each of the three States reported that there was no discussion of science curriculum materials at all during their pre-service education. An examination of data on the type of specialist academic training of all teachers in the sample indicated that about eight percent of all respondents described this part of their training as 'primarily in a field other than science' (see Table 6.6). Thus, some young teachers found themselves teaching science when their training was in some other academic discipline. In addition it was possible to complete some teacher training courses as a prospective science teacher without taking subjects which included an intensive study of Year 7-10 science. In these courses students choose between a number of 'method' studies, and the choice is sometimes between a specialist discipline, such as physics or chemistry, and science. In these cases there would have been no opportunity for the teachers in training to have encountered ASEP materials.

To gain some idea of the relative influence of pre-service education courses in promoting ASEP, values were assigned to each of the categories of emphasis on ASEP as indicated in Table 7.3. The values enabled means and standard deviations to be calculated. These are also included in Table 7.3. An analysis of variance carried out on these data showed that significant differences existed between the States (p <.01) so a Scheffe (1959) multiple range test was used to search for homogeneous State groups. As indicated in Figure 7.1, two homogeneous groups were identified; Queensland and Victoria formed one group and South Australia the other. This was an intriguing result in that the rank order of the 'press for ASEP' from pre-service institutions was the reverse of the extent of adoption of the ASEP materials in the States. In Queensland it was evident that the majority of prospective science teachers took courses in which there was a strong emphasis on the ASEP development. By contrast, almost one-half of all beginning science teachers in South Australia in the period 1973 to 1975 entered schools without being made aware of the range of any of the curriculum materials available for use in science.

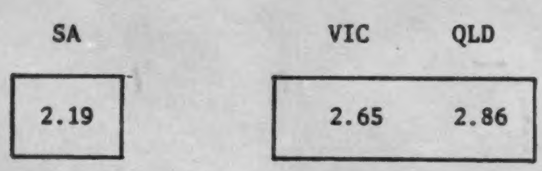

Figure 7.1 Pre-Service Emphasis on ASEP : Homogeneous Subsets of State Means

User Participation

The claim that participation in the formative stage of an innovation affects its subsequent implementation rests on two assumptions. The first is that involvement in the creation of an innovation leads to a commitment to its use as a finished product. Secondly, it is assumed that user participation in the production of an innovation is an efficient means by which its essential characteristics are absorbed by those who will be ultimately concerned with its use.

Participation appears to be of particular significance if the curriculum innovation has radically different features to curricula currently in use. Rudduck (1977) maintains that changes are required of users in this situation which involves an encounter of cultures, in which the user must adjust to a new set of norms or values incorporated into the new materials.

The executive of ASEP was aware that the concepts and organisation of the development required teachers to modify their teaching methods. They drew up plans which would have enabled many teachers to participate in the trials of the ASEP materials. However, the extent of these trials was, in practice, reduced due to financial constraints. Most trials were not controlled by the ASEP central office directly, but through State Advisory Committees, and tended to be subject to State level controls.

To assess the impact of these trials Heads of Science Departments in schools which had used ASEP materials were asked to consider the influence of school trials on the decision to adopt ASEP materials. The response patterns are outlined in Table 7.4. They indicate that the majority of schools were unaffected; the percentage of responses in this category ranging from 62 percent in South Australia to 80 percent in Queensland. To assess the relative impact of ASEP trials between States, values were assigned to each category or degree of influence. These ranged from five to one corresponding respectively to 'extreme' and 'none'. These values enabled a mean value and standard deviation of the impact of ASEP trials to be calculated for each of the States, and these are included in Table 7.4.

Table 7.4 Percentage of Schools Versus Effect of Trials on Adoption: By State

Degree of Influence		Victoria (N=45)	Queensland (N=48)	South Australia (N=43)
Extreme	(5)	2	0	0
Major	(4)	11	7	10
Moderate	(3)	14	7	18
Slight	(2)	8	7	10
None	(1)	65	79	62
		100	100	100
Mean level of Influence in Trials		1.77	1.43	1.76
Standard Deviation		1.17	1.18	1.07

Item: Indicate the relative importance of the following reason for ASEP materials being first purchased in the school. 'The science department or those concerned with teaching science were influenced by a favourable trial in the school.'

Note: Figures in the main body of the Table are percentages of all schools which used ASEP to October 1975.

An analysis of variance carried out on the data showed that differences in the impact of trials between States were significant (p <.01). The multiple range test (Scheffe, 1959) was used to identify significant differences in State means. The homogeneous groups of States are shown in Figure 7.2. There was a significant difference between South Australia and Victoria on one hand, and Queensland on the other.

QLD	SA	VIC
1.43	1.76	1.77

Figure 7.2 Effect of ASEP Trials : Homogeneous Subsets of State Means

These results were also used to obtain an indication of the extent of trialling of ASEP in each of these States. In order for a Head of a Science Department to respond in any category from 'extreme' to 'slight' in Table 7.4 the school must have taken part in a trial. The percentage of all schools which reported that ASEP trials influenced their decision to purchase was found by adding the percentages of the responses from 'extreme' to 'slight' in Table 7.4 and multiplying this by the percentage of schools which had adopted at least one module pack of ASEP materials up to October 1975. These data are outlined in Table 7.5 and indicate that in Victoria and South Australia about three schools in ten took part in some form of trial before deciding to use ASEP materials. However, in Queensland, less than one school in ten was affected by the trialling of ASEP units such that use of the materials subsequently took place.

To test for differences in the influence of trials on schools in the States, a procedure attributed to Zubin (1939) was employed. The use of scales enables a critical value of significance to be found which depends upon the size of the samples. Another scale enables the percentage difference to be converted into a difference value which must be greater than or equal to the critical value at one of the customary levels of significance (see Oppenheim, 1968). The results of this sequence of calculations for this study are shown in Table 7.6.

Table 7.5 Percentage of Schools Influenced to Adopt by Trials: By State

Percentage of	Victoria (N=45)	Queensland (N=48)	South Australia (N=43)
Schools Adopting ASEP Module Packs up to Oct.1975 (a)	81	40	88
Schools Adopting ASEP Which were Influenced by Trials (b)	35	21	38
All Schools Influenced to Adopt ASEP by Trials (a x b)	28	8	33

Table 7.6 Effect of Trials : State Differences

States Being Compared		Critical Value	Difference in Percentage	Difference Value (at 5%)	Decision
VIC (N=43)	QLD (48)	0.21	28-8=20	0.27	SIG
VIC (43)	SA (42)	0.23	33-28=5	0.05	ns
QLD (48)	SA (42)	0.22	33-8=25	0.33	SIG

There was no significant difference in the percentage of schools affected by trials of ASEP materials between South Australia and Victoria. However, there were significant differences between the percentage of schools affected in Queensland compared with both Victoria and South Australia. These patterns are consistent with the extent of penetration of the ASEP materials into schools in the three States and they suggest a link between impact of trials and extent of use of ASEP materials within the States.

Change Agent Contact

Knowledge about trends in science teaching have also been transmitted to schools by science inspectors and consultants.[4] Inspectors have been employed by government educational authorities for many years. Generally they have been promoted to inspectorial positions after successful careers in schools. In addition to appraisal roles, they have traditionally been involved with planning and guidance of school programs and with teacher education. Inspectors have therefore been in a position to influence the direction of change in schools, including the implementation of developments in curricula. Changes in the administration of schools and school systems in Australia during the past decade have affected the roles of inspectors. The result has been that they spend less time on appraisal than previously and a greater emphasis has now been placed on them as innovators; in consultative committee work and in devising structures intended to improve communication with schools.

An important recent additional development in educational systems in Australia has been the appointment of advisory personnel. Between States the relationships between inspectors and advisers vary but, in general, while inspectors have a wide responsibility for the planning and organisation in an area of curriculum, advisers tend to work at the local or school area. Advisers have generally been located in a region acting as linkage agents between teachers and the administration and assisting in curriculum implementation. The centralised administration of education in Australia requires that most subject area inspectors are based in capital cities and this has further prompted education departments to appoint advisers in regions within States.

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[4] In Australian educational systems the terms 'consultants' and 'advisers' are used synonymously. They are used interchangeably in this report.

Both inspectors and advisers have thus been in a position to influence the curriculum offered in schools. To gauge teachers' opinions of the extent of support given by inspectors and advisers in science to ASEP as a medium for organising the science curriculum, an appropriate question was included on the Teacher Questionnaire. The responses are recorded in Table 7.7.

Within each State there was a range of responses which indicated variability in the advice given by inspectors/advisers to different teachers. The most striking result in Table 7.7 is the high proportion of teachers in each State who had no knowledge of the attitudes of inspectors/advisers to the different curriculum materials available. To test for the overall effect of inspectors/advisers numerical values were assigned to each response category to obtain a mean value for each State on a scale which measured the extent of support of ASEP. A one-way analysis of variance applied to these figures revealed significant difference between the States ($p < 0.01$). The results of a Scheffe test for differences in means are shown in Figure 7.3. The figure shows ASEP received significantly more support as a resource from inspectors and

Table 7.7 Percentage of Teachers Versus Perceptions of Science Inspectors'/Advisers' Attitudes to ASEP: By State

Perception	Victoria (N=288)	Queensland (N=319)	South Australia (N=285)
Active promotion of ASEP, more emphasis on ASEP than other science materials (4)	10	2	17
Promoted other materials as well as ASEP, no marked emphasis on ASEP (3)	13	25	28
Attitude of inspectors/ advisers not known (2)	77	67	54
Promoted other materials rather than ASEP (1)	0	6	1
	100	100	100
Mean level of support by Inspectors/Advisers	2.37	2.23	2.63
Standard Deviation	0.67	0.65	0.77

advisers in South Australia than was the case in the other two States. This feature apparently was associated with a greater proportion of teachers having a knowledge of the views of inspectors/advisers in South Australia than in the other States; 46 percent in that State compared with 33 percent in Queensland and 24 percent in Victoria. This suggested that

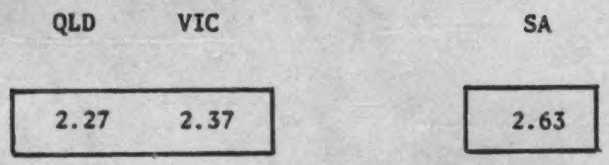

Figure 7.3 Inspectors'/Advisers' Attitudes to ASEP: Homogenous Subsets of State Means

there was far more personal contact between inspectors and advisers on the one hand and teachers on the other in South Australia than in Queensland or Victoria. Of the respondents who implied a knowledge of the attitudes to curriculum materials in Queensland about one-fifth (6/33) reported that inspectors/advisers promoted curriculum materials other than ASEP. This was interpreted as suggesting that there was an underlying objection to the widespread use of ASEP by at least some of the advisory personnel in the State. This is an intriguing result in view of the fact that the outline syllabus for science in Queensland (to be discussed in the next chapter) has a set of aims which are strikingly similar to those underlying the ASEP development.

Concluding Comments

In this chapter possible explanations for variations in the average extent of adoption of ASEP materials between States were considered. The discussion focussed on mechanisms or key strategies which may have operated to encourage the choice of ASEP materials for use in school science programs. These strategies were selected for examination after reviewing other research on adoption and use of educational innovations.

The results indicated that no comprehensive ASEP dissemination program was carried out in any of the three States investigated. Whilst it was possible that science teachers took note of journal articles about ASEP, the majority were unaffected by teacher education courses, few were involved in trialling the materials, and many knew nothing of the attitudes of change agents toward the ASEP development.

From the analyses set out in this chapter several conclusions can be drawn. First, attendance at ASEP inservice courses did not account for differences in adoption. Nor did the inclusion of ASEP in pre-service education account adequately for variation between States, since emphasis in pre-service education was negatively correlated with extent of adoption. Secondly, although few teachers took part in the trials, participation did account for differences in adoption between States. Likewise, the appearance of journal articles in State journals can be associated with extent of adoption. Finally, the roles of inspectors/advisers, i.e. change agents, appeared to be the strategy most strongly associated with adoption. In particular, the influence of these change agents was noted in South Australia, where the extent of adoption was high and remained so over time.

CHAPTER EIGHT

FACTORS AFFECTING THE LEVEL OF MEDIUM SUPPORT FOR ASEP

In the previous chapter strategies were examined which were likely to be employed in State educational systems to assist schools to incorporate ASEP into science programs. A profile was developed of the extent of system level support for ASEP and the relative effectiveness of the support in each State was compared and contrasted.

This chapter is devoted to an examination of underlying factors which contributed to the level of medium support for ASEP in each State. This analysis required a consideration of historical, political and administrative aspects of the State educational systems with particular reference to their influence on science teaching in secondary schools. Evidence was collected during visits to each of the three States and was analysed under three major headings:

(1) structural factors;

(2) links with the resource; and

(3) factors affecting implementation.

Structural Factors

Structural factors of the educational medium are those which combine to influence the way the curriculum is planned and taught within an educational system. These factors are manifest in documents such as curriculum guidelines, syllabuses and examinations. Structural factors may exert an influence over a school or on a particular department or subject area group within a school. They may influence the underlying rationale of the total program and result in modifications to the balance of subject offerings. In addition, or alternatively, structural factors may shape the way teaching and learning are approached.

At the subject area level structural factors may influence the content of courses, teaching methods or even the organisation of material resources. They may also determine the ways in which subject programs are evaluated.

In this study the major concern was to discover the influence of structural factors on the adoption and use of ASEP by teachers of science in each State.

Links With the Resource

The transfer of knowledge about an innovation from resource to users by educational medium agents depends on the use of key strategies. When a resource has limited direct access to users, medium level agents have a strong influence in promoting new knowledge. It is contended that the attitude formed by medium level agents toward an innovation during its development help to determine the extent of system level support given to it when it becomes available to users.

In this study attention was focussed on the activities of individuals or groups in each State who were in a position to influence the way science was taught in secondary schools, and the relationships between these individuals or groups and the ASEP team during the period of the ASEP development.

Factors Affecting Implementation

As shown in the literature review in chapter Three, certain strategies employed by agents in the educational medium appear to be important in assisting with the implementation of educational innovations. This form of support is an indication that the underlying rationale of the innovation is approved of by those outside schools who have the power to influence curriculum change, and who have the ability to arrange mechanisms by which this power can be exercised to promote the new curriculum. These are termed the Factors Affecting Implementation.

This study investigated the ways in which links between the educational medium and users were arranged to facilitate the planning of science programs based on the ideas and materials of the ASEP endeavour.

These three factors formed the basis of a study of the ways in which three educational systems approached the introduction of ASEP ideas and materials into the schools in each State. To facilitate comparison, it was deemed convenient to consider Queensland first, then South Australia, and finally Victoria.

Queensland

In chapter Six it was shown that, in terms of both the average adoption of ASEP materials and the number of schools which had bought ASEP units, the relative impact of the materials in Queensland was low compared with all other States except Western Australia. In Queensland only one school in five had purchased more than 20 ASEP module packs and over 50 percent of all schools had not bought ASEP materials at all by February 1976, two years after the first units became available to schools.

The summary presented at the conclusion of chapter Seven indicated that, relative to the other two States examined in detail, there were fewer mechanisms in Queensland to assist schools with the use of ASEP.

These results stimulated the more detailed examination of system level effects which are presented below.

Structural Factors : Queensland

In discussing the influence of syllabuses, examinations and other curriculum guidelines, it is necessary to consider how the contents of these documents are modified over time. Schools can be slow to adopt changes and their programs may be based on superseded principles. Identification of obsolete guidelines can throw light on the ways schools, and subject departments within schools, function.

To gain an historical perspective an appropriate time span must be selected in order to encompass significant features which affect the question under review. A logical commencement date for examining structural effects on science teaching in Queensland is 1964. This was the year in which large-scale changes in the administration of education took place. A major result of the Education Act of 1964 was that students were now able to move from primary to secondary school without a qualifying examination which had, up till then, restricted such promotions. Also the age at which students moved from the primary to secondary school was reduced from 14 to 13, and the school leaving age was raised from 14 to 15. Consequent changes occurred in the nature of the secondary school population. Whereas formerly secondary education had focussed on students of higher academic ability, the Act recognised that:

> for every child attending a secondary school there shall be provided secondary education, that is to say, having regard to the age, ability and aptitude of the child concerned and to the period for which he is expected to receive education, progressive course of instruction in such subjects as of such duration as the Minister approves.
>
> (Queensland, Education Act, 1971:8)

One of the secondary school subjects the Minister approved was science and, from 1964, a course in science (or junior science) replaced studies in the separate science disciplines in Years 8-10. Responsibility for courses in these years came under the jurisdiction of the Board of Secondary School Studies and it appointed committees to consider what should be taught in the subjects offered. A Science Advisory Committee was formed and one of its first tasks was to write a syllabus for junior science. The result was a document setting out some broad aims and a list of topic outlines in six separate subject areas; astronomy, biology, chemistry, geology, physics and physiology. In the preface to the detailed outline it was stated that:

> No attempt has been made to 'integrate' this material as has been done in other courses of this nature. This decision was taken for several reasons. It was felt that there were, in each of the separate sciences, concepts and processes which belong to that science alone and should be treated accordingly. Also, since students taking one of the courses set out below would be proceeding to a study of separate sciences in later years, it was considered essential that a sound background for further study should be provided. So called 'integrated' courses are often nothing more than a series of unrelated topics in which it is difficult to detect a unifying theme either within topics themselves or throughout the course as a whole.
>
> (Queensland.Department of Education, Syllabus in Junior Science, 1964)

Thus the thrust of the syllabus at this time was 'subject centred', and a heavy emphasis was placed on the needs of those students who would continue with further studies in the sciences in the senior school.

After the publication of this new syllabus a series of textbooks was written designed to cover the material outlined. It was not surprising that these texts, the 'Exploring the Sciences' series, emphasised the content matter included in the syllabus. In retrospect, these texts were considered by curriculum officers and science advisers and inspectors as unsuitable for many of the students who took the course because of the advanced level of the content matter and the sophisticated language used. As one science inspector recently remarked, these texts were 'just so far above the average kid that they were a complete and utter waste of time'. Despite this, a small proportion of Queensland's secondary schools continued to regard these texts as the major source for teaching science in 1975 (see appendix 7/2). This suggests that, in these schools, little change had taken place in the approach to science teaching in the decade since the 'Exploring the Sciences' series was written.

By 1967, there was evidence that changes to science teaching had begun to influence the curriculum constructors. In the syllabus released in that year it was stated that:

> In recent years, the methodology of science teaching has undergone a change. The emphasis now is on providing students with an opportunity to discover relationships for themselves, to develop their own explanations and to apply what they have learnt to new situations.
>
> (Queensland Department of Education, Syllabus in Science (A+B), 1967.)

Concern in this syllabus for an expanded range of outcomes for science teaching led to a reexamination of the nature of resource materials available to teachers. This was a period when, as outlined in chapter Two, there had been a move away from the use of a 'standard textbook' to the use of a more diverse range of science materials in some Australian State educational systems. Such a trend was not followed in Queensland. Instead, another range of textbooks, the 'Modern Science' series, appeared, which was keyed to the revised science syllabus. These texts, written by a local science master, were used in the majority of schools in the late 1960's and early 1970's. Compared with the 'Exploring the Sciences' series, the 'Modern Science' texts were more suitable for the majority of students. The content was less oriented towards those proceeding with science in the senior school. The use of colour and an informal format made the texts more appealing to more students. These texts also encouraged teacher demonstrations as a complement to more didactic methods of instruction. Despite these changes the general approach to teaching science in Queensland retained its traditional flavour, with an emphasis on underlying subject disciplines.

It is difficult to determine accurately the reasons for the non-introduction of science courses based on contemporary trends such as cross-disciplinary topics, enquiry-based learning and the use of materials other than a single textbook. However, one factor can be identified; the quality of science facilities in schools during this period. Figures relating to the adequacy of science facilities were collected in a national survey by the Australian Science Teachers' Association (Keeves, 1966). It was shown that, in 1961, in Queensland's government schools, 33 percent of science rooms had no laboratory benches and 86 percent of these rooms were considered 'unsatisfactory' in terms of criteria set down by the Association.[1]

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[1] The criteria were as follows:

(a) Bench space: 2.5 ft per student.

(b) Taps and sinks: 2 per room in biology and physics and 1 per 4 students in chemistry and science.

(c) Gas outlets: 1 per 2 students.

(d) Power points: 1 per 2 students in physics and biology and 2 per room in chemistry and science.

(e) Fume cupboards: 1 per room in chemistry.

Also there were shortages of teaching and support staff with appropriate qualifications. The survey concluded that no laboratory assistants worked in government schools, and 36 percent of all teachers of science did not possess tertiary qualifications in science.[2] However, some of these features were not confined to Queensland and further reasons need to be sought to explain differences in the way science courses in schools evolved over time in the different States. The net result of the Queensland developments, however, was that it became the norm for science teaching in Queensland secondary schools to be based on work covered in a textbook series; textbooks which adequately covered content outlined in a centrally organised syllabus based on traditional subject disciplines.

The combination of lack of laboratory facilities for students to carry out their own experiments, inexperience and the lack of appropriate scientific knowledge by teachers, and a set syllabus for which texts were readily available led to a style of science teaching in the late 1960's and early 1970's which was described by a senior official of the Education Department as 'mostly teacher directed, mostly chalk and talk, the odd demonstration with the odd bit of prac work to verify what had been taught'!

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[2] For comparison the following figures are presented for the three States (government schools) 1961 (After Keeves, 1966)

	VIC	QLD	SA
Percentage of rooms without laboratory benches	19	33	16
Percentage of 'unsatisfactory' laboratory rooms	86	86	53
Average number of laboratory assistants per school	0.07	-	0.25
Percentage of science teachers without tertiary science qualifications	32	36	40

Developments in the Early 1970's In 1969 a committee formed by the then Minister for Education and Cultural Activities (Sir Alan Fletcher) was to have an enormous impact on structural factors which affected the whole of secondary education in Queensland. The committee, headed by Dr. W.C. Radford, reviewed public examinations taken by secondary school students and recommended that at both junior (Year 10) and senior (Year 12) levels, a system of school assessment combined with between school moderation be used to evaluate student performance.

The specific recommendations about the form and administration of the Junior Examination were that:

(1) control over the nature and award of the Certificate be vested in a statutory authority to be called the Board of Secondary School Studies. (para 5.12)

(2) the Board approve syllabuses recommended by the Subject Advisory Committees on which teachers will be in the majority. Syllabus will present a broad framework of the subject and not prescribe its detail. (para 5.14)

(3) schools have freedom to choose the detail to fill out a syllabus, freedom in method of presentation of an approved syllabus, and within the moderation system, freedom in methods of assessment of student performance. (para 5.16)

(4) those responsible for pre-service and inservice education of teachers ensure that teachers likely to be engaged in school assessment are conversant with appropriate procedures. (paras 7.08 and 7.09)

(5) provision be made for teachers involved in devising courses of study to discuss questions such as objectives, syllabus construction and examining techniques. (para 7.10)

(Queensland. Public Examinations for Queensland Secondary School Students, 1971)

The entire set of recommendations was accepted and implemented in the Education Act Amendment of 1970 (No. 2). The Act abolished the single end of year examination in each subject as the sole means of student assessment at both junior and senior levels.

For teachers and education administrators the implications of the Radford Report were enormous. If the recommendations were to be fully implemented, it would mean that a traditional system of central control would be transformed into one where responsibility for decision-making about curriculum matters would reside with the schools; teachers were to be given responsibility to plan the details of their courses. The acceptance of the Radford Report paved the way for changes in teaching methods and content of courses.

Any analysis of developments in science education in Queensland in the 1970's must take into account the impact of the Radford Report. Arising from its recommendations advisory committees were set up to plan outline syllabuses in the major subject areas. The science committee decided that the framework around which science courses in secondary schools should be based should cater for integrated science in Years Eight to Ten and separate subject disciplines in Years 11 and 12 (Queensland.Science Advisory Committee Minutes, 7-10 December 1972). The Science Advisory Committee (sac) adopted an approach to science teaching which had not been incorporated into previous syllabuses in Queensland, an approach which began by considering the place of science in the general education of all secondary school students. In an early meeting of the sac the following questions were considered as forming the basis for the construction of an outline syllabus to guide schools:

(a) What is the purpose of science education in secondary schools?

(b) What are to be the aims of science education in secondary schools? and

(c) What procedures will be employed to organise the learning experiences and selection of content?

(Queensland. sac (science), 29 September 1971.)

The final form of the outline syllabus produced by the sac included statements which reflected a modern view of science. The aims underlying the new curriculum included:

> knowledge and understanding of man, his planet, the universe and the relationships between them;
>
> knowledge and understanding of science - its structure, breadth limitations, historical development and relationship to other forms of human endeavour;
>
> manipulative and communicative skills, abilities and attitudes important in scientific investigations; and
>
> appreciation and concern for the products and influence of both science and technology.
>
> (Queensland.Board of Secondary School Studies, Syllabus in Science, 1973:2)

These aims are of the same form as those which guided the ASEP development (ASEP, A Guide to ASEP, 1974). The syllabus also contained a list of suggested topics for Years 8-10 in the major science disciplines and provided a program construction checklist.

A major revolution had occurred in the structure of science education in secondary schools in Queensland. First, there was a change in control of course development and assessment. There was a major shift from external examinations to school-based assessment. Secondly, science, which had previously been designed for the more able students, now became an essential element in the general education of all students. This led to an expanded list of objectives which guided the construction of the outline syllabus. There was a reduced emphasis on knowledge and a consequent stress on the understanding of concepts and the acquisition of scientific skills and attitudes.

These changes opened up the way for the adoption of ASEP materials by schools. However, from the results presented in the previous chapter, it is obvious that system level agencies did not mount activities to enable teachers to capitalise on these changes. To explain this it is necessary to examine other developments in science education in Queensland.

Links With the Resource : Queensland

As outlined in chapter Two all States agreed initially to support the ASEP development. This support took the form of funds, or the secondment of staff to work at the Project's headquarters in Melbourne. To keep ASEP before the science education community at large, State Advisory Committees (SAC) were formed.[3] The SACs included representatives from schools, tertiary institutions and employing authorities. The SAC chairman generally represented the interests of the State Department of Education and provided a personal link between key management groups. This person had a vital role in deciding the future dissemination of the ASEP ideas and materials through the provision of support at the system level. An important feature of the SACs was that they included science educators who were in a position to encourage teachers to adopt the innovation into their school programs and to adapt their teaching to the principles espoused by the ASEP developers.

The major tasks of the SACs were: to review the progress of the ASEP development, to make recommendations about the needs of schools in the State, to arrange National Trials of ASEP materials and to distribute information about the ASEP development and materials. From an analysis of documents and from interview data it was possible to determine the extent of support given to ASEP by the SAC (Queensland). Information collected in the State makes it clear that the SAC (Queensland) was rarely called together; there is evidence of two or at the most three meetings during the years of the ASEP development (Robins, 1976). There appeared to be little commitment of the SAC (Queensland) as a group[4] to assist with the ASEP endeavour. For example, when reporting on Queensland reaction to the format of first draft ASEP units, the Chairman of the SAC (Queensland) reported that:

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[3] SAC is used to denote the State Advisory Committee. This was a distinct and separate group from the subject advisory committee (sac) in Queensland.

> inspection packs of trial units received had been distributed (to Queensland SAC members) to receive comments ...... Evaluation of units is left to the discretion of individual[4] members of the SAC.
>
> (ASEP. COM Minutes, 4 October 1971:4)

The activities of the SAC (Queensland) contrast to those of the SACs in Victoria and South Australia where there was a strong corporate effort to provide feedback to the ASEP team.

The SAC (Queensland) was responsible for the administration of the National Trials in the State. Although most of the data show that the SAC (Queensland) was not greatly concerned, it appeared that it was supportive of ASEP in their initial efforts to secure the cooperation of science teachers in this phase of the development. In a circular to principals of schools, asking for teacher participation, the SAC (Queensland) Chairman wrote:

> The SAC regards these trials as an integral part of the development of the materials being prepared by the ASEP Project. It is considered that they have an important role in ensuring that what the Project produces will be suitable for schools in Queensland and will receive a ready acceptance by teachers in this State.
>
> (Queensland. State Advisory Committee file, 20 October 1971)

The trials were organised by a coordinator (K.S.G. McKenzie) who became a key figure in the dissemination of information about the ASEP development.

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[4] My emphases.

At first 24 teachers in 24 schools took part in the National Trials of ASEP during 1971 and 1972. In an effort to spread information about ASEP materials in Queensland, McKenzie produced a series of nine newsletters throughout 1972 and 1973 designed to;

> keep trials teachers, the sac and other interested persons informed of the progress of the National Trials in Queensland.
>
> (Queensland. State Advisory Committee file, July 1972)

During 1972 and 1973 about 40 teachers were involved in ASEP trials. This was the number requested by the ASEP development team. However, for adequate dissemination of information about ASEP, more teachers had to be exposed to ASEP materials during their formative stage. This was acknowledged by SAC (Queensland) (Queensland State Advisory Committee file, 5 August 1971). There is no evidence, however, that the Queensland SAC made any attempt to circulate trial materials to a large number of teachers, despite suggestions made by some members of the SAC (Queensland) at its earliest meeting (Queensland State Advisory Committee file, 7 April 1971).

Factors Affecting Implementation : Queensland

Here attention is on the linkages which were set up after the ASEP team disbanded in 1974, when the ASEP materials became available to schools. This was also the period in Queensland when the outline syllabus became effective in its final form. There was little difference, in principle, between the official 'Board of Secondary School Studies' stance on the objectives of science teaching for Years 8-10 and those underlying the ASEP development. As such, it was expected that there would be support from change agents such as inspectors, advisory personnel, curriculum officers and others for the use of ASEP units in schools. However, as has been shown in chapter Seven, this did not occur via the strategies reviewed there. The underlying reasons for the lack of congruence between what might have been expected and what actually took place are puzzling.

The question of extent of support for ASEP in Queensland becomes closely associated with another issue; to what extent did science teachers in Queensland have access to materials and methods to help them to build a curriculum based on the outline syllabus? Teachers of science had been accustomed to being directed, using a syllabus which emphasised the importance of content. Didactic teaching methods had, for the most part, been employed using a single textbook as a resource. These factors made it probable that the science staff in secondary schools needed assistance in adjusting to the new situation. This had been recognised in the Radford Report.[5]

Information from interviews, from files, and other sources shows that there was some inservice training conducted to familiarise teachers with the outline syllabus for science. This consisted of a series of one or two-day meetings in each region of the State during which the Chairman of the Science Advisory Committee and others outlined the changes embodied in the outline syllabus. These meetings were an introduction to new developments and there was little scope for teachers to consider which of the available curriculum materials would be suitable for use to implement the objectives of the outline syllabus. Publicity about ASEP to teachers was not widely disseminated through these meetings.

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[5] See recommendations four and five of the Radford Report, which are included on page 154 in this thesis. These suggested that extensive programs in all aspects of curriculum development for teachers were necessary for the objectives of the Report to be achieved.

There was, in fact, no intensive inservice program through which ASEP was introduced to science teachers in Queensland. The small number of courses available were organised by the Science Teachers' Association of Queensland or by individual teachers' colleges.

Other sources of support for teachers in planning of science courses were science inspectors and advisers. The nature of their roles and their continuing personal contacts with teachers gave them an opportunity to promote change. However, data collected suggested that inspectors had not mounted State-wide programs to introduce teachers to the basic principles of curriculum development based on the outline syllabus. There appeared to be a reluctance by them to foster school-based curriculum development. Partly, this appeared due to their lack of preparation for these tasks. One said:

> I certainly haven't got any training in curriculum development. I don't feel competent to lead anybody in the field. I'm just a classroom teacher like everybody else ..... who's moved up the ladder and that's the way it goes.

In addition, inspectors had a large proportion of their workload devoted to teacher appraisal. This reduced the time they could spend on devising methods to assist teachers with planning science courses. The joint responsibility for appraising teachers and advising them was another factor which reduced the effectiveness of inspectors in promoting change. Teachers in Queensland, like their counterparts elsewhere, found it difficult to accept advice from an inspector when it was possible that the inspector could shortly be judging the teacher's performance and deciding on his future promotion.

Another possible resource were advisers but they were of little assistance in school-based curriculum development because so few were appointed. In 1975 there was only one advisory teacher for science in Queensland despite the fact that each of the nine education regions advertised a position. Several factors contributed to this. First, the salary did not attract experienced Heads of Science Departments to leave their schools for a post which entailed moving around schools in a region. In country regions, large amounts of travelling were involved. Secondly, there were few promotion rewards for teachers in an advisory position, and indeed holding such a position may have been detrimental. One administrator remarked in an interview that:

> ...... a good science subject master is not going to leave his school for three years, because he's interested in further promotion, and he feels at a disadvantage in his own career structure ... they (the subject masters) feel that they'd miss out. But you know, instead of being put on the road for the three year maximum period as an advisory teacher, they rather stay in their schools, be appraised and hope to become deputy principals.

It seemed that the system penalised rather than advanced those who worked in advisory roles. Under these circumstances those most needed for these positions, the experienced science teachers, did not apply. This meant that there were few agents 'on the road' whom science teachers could approach for assistance with their school-based program planning and execution, or for information about new materials and techniques in teaching.

These circumstances led to a barrier in the dissemination of information about suitable curriculum resources for science. It was not surprising that, as reported in chapter Seven, almost four-fifths of science teachers reported that they had no knowledge of the attitudes of inspectors and advisers to ASEP, a major new curriculum development.

Perhaps, as a result of these factors, there was reliance by science teachers on the facilities of the Curriculum Branch of the

Education Department in Brisbane. Some of the services provided by the Branch related to general aspects of curriculum planning. These included a range of publications such as those of the Inservice Science Teacher Project (INSTEP) and those devoted to reviews of currently available resources for science teaching. Teachers were able to inspect and borrow various curriculum materials, particularly the ASEP units. In fact, the Branch housed two complete sets of ASEP materials and, during the 1975-1976 period, these were continuously on loan to schools.

To recapitulate, guidelines for science teachers changed rapidly in the decade from 1964. Written statements produced in 1974 suggested an expanded role for science in the junior secondary school and encouraged new methods and approaches. In addition, there was a change in the control of the curriculum. These two elements taken together made it essential that teachers receive support and guidance in planning science curricula. The evidence suggests that, up to 1976, this had not been provided by the most likely change agents, inspectors and advisers. Lack of support and guidance for science departments in constructing programs based on the outline syllabus affected the use of suitable curriculum resources. ASEP units fell into this category. These materials received tepid support during their trials in the State and little system level promotion after they were released in their final form.

South Australia

The results of analyses carried out in the previous chapter indicated that science teachers in South Australia had few opportunities to learn about the ASEP development in formal inservice courses, or through pre-service training. Rather, the major thrust of support for ASEP came from inspectors and advisers working with teachers in schools. This commenced when the ASEP materials were distributed in their trial form, and continued when the final form of the materials was implemented in school science programs.

Structural Factors : South Australia

As for Queensland it is important to consider developments which occurred over time in the organisation of science education in South Australia, with particular reference to the change in control of the curriculum. It is thus possible to identify the roles of agencies external to schools which influenced approaches to science teaching and learning, and the way in which these agencies affected structures such as outline syllabuses and examinations.

Movement toward the devolution of curriculum control to schools in South Australia commenced in 1968, when the Intermediate Certificate, controlled by the Public Examination Board (PEB), was abolished. From that year schools had the major responsibility for planning of their own curriculum. There was immediate recognition within the Education Department of South Australia that guidelines for the administration of schools were necessary if schools were to experience a smooth transition to the new form of government. An analysis of key documents circulated to schools over a five-year period permitted the following conclusions to be made regarding the way the Junior Secondary Schools' (Years 8-10) curriculum evolved during the late 1960's and early 1970's:

(1) The Junior Secondary School curriculum was conceived as forming a general education for students with a wide range of abilities, as virtually self contained

and as independent of the curriculum in the upper secondary school.

(2) The Junior Secondary School curriculum was to be student-centred, rather than topic-centred, in which a variety of teaching methods were to be used. It was designed to offer, as far as possible, equal opportunity for all students.

(3) There was to be continuous assessment, rather than a single end of year examination, and schools were to be responsible for assessing their own students to Year 10, with letter grades rather than marks.

(4) Curriculum committees were to be formed to set down guidelines for the conduct of subjects in schools, but schools were free to, and expected to, modify aims and content.

(5) Individual differences in students were to be catered for by 'tracking' students in individual subjects.

(6) A core of common subjects was to be offered, with scope for schools to select suitable electives. Science was part of the core, and was to be taught in all schools for a prescribed amount of time each week.[6]

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[6] The major documents, which are summarised here as follows:

1968 Document 33:68 'The Secondary School Curriculum. Planning for Courses in 1969.'
1970 'Memorandum to Heads of Departmental Schools : Freedom and Authority in the Schools' (A.W. Jones, Director General of Education).
1970 Circular 3:70 'Change in a School's Curriculum'
1971 'The Purposes of Schools'
1972 'Policy on Secondary Curriculum in South Australia'

(See South Australia. Education Department (1976a): Jones (1977))

Through these guidelines the Education Department in South Australia attempted to initiate curriculum change in schools and to restrict the abuse of "school autonomy".

Science was included in the core curriculum of secondary schools. In accord with the suggestions of the Education Department an advisory committee for the subject, the Secondary Science Curriculum Committee (SSCC), was formed in 1970. The brief of the SSCC was to:

> (1) advise the Assistant Superintendent of Secondary Education (Curriculum) on matters associated with science education in secondary schools. In particular, to approve syllabi in use only in Departmental schools,
>
> (2) advise the Inspector in Charge of Commonwealth Science grants and supply of apparatus,
>
> (3) advise on the design of science accommodation,
>
> (4) set up, guide and encourage working committees in aspects of science education, and
>
> (5) act as a general watching and coordinating committee and source of up to date information on science education in South Australia.
>
> (South Australia. SSCC Minutes, Attachment 3, 1970.)

The committee was originally composed of inspectors, consultants, teachers' college lecturers and secondary teachers who met informally in 1969 to examine some of the current problems in science in South Australia. The SSCC provided a forum for different groups where teachers had direct access to inspectors and others who controlled the allocation of resources to schools. There was also the possibility of those working at the system level to obtain feedback from teachers who had trialled new curricula and methods of assessment in the schools. Consequently, teachers could influence decision making. This eased traditional tensions between teachers and those who were senior to them in the educational hierarchy.

The SSCC had another advantage for, through it, those engaged in writing outline science syllabuses obtained reactions from a variety of people. During the early 1970's outlines were produced which, in general, were written for a wide ability range in students and for different types of schools (such as technical and small country or area schools). Course outlines were also written for senior school science as alternatives to the traditional subject disciplines (one example was a Physical Science Course).

These syllabuses were important indicators of the way leading science educators viewed the study of science, particularly in the junior school. Even under the PEB there had been attempts to introduce science courses which were consistent with advances in science education. For example, the 1968 PEB science syllabus included the following aims:

to - (1) make the student aware of his physical environment,
(2) present material so that the student should acquire sufficient knowledge to cope with modern society and the changes taking place in that society,
(3) convey the importance of scientific method,
(4) allow students to experiment in order that they acquire basic manipulative skills,
(5) present science as an integrated whole rather than as separate subjects.

The syllabus considered the needs of three groups of students. These were:

(1) students of the humanities (who need to know the value of scientific knowledge),
(2) future technicians and technologists (who need to be able to use scientific knowledge), and
(3) students of the pure science (who need to be able to think carefully about science).

(University of Adelaide, Manual of Public Examinations, Part I, 1967:84.)

Clearly, some of the concepts which were to frame the ASEP endeavour were already evident in curriculum development in South Australia.

Another development, which became a key factor for the adoption and use of ASEP materials in the future, was the appointment of a select group of senior science teachers to act as curriculum consultants or advisers. They were employed, from 1968, to assist with the solution of difficulties in schools caused by rapid changes in curriculum control and by the shortages of appropriately trained teachers.

The employment of consultants per se does not necessarily guarantee their effectiveness as change agents. However, the manner in which these South Australian consultants approached their task and their relative autonomy were factors contributing to their effectiveness. Over time they established trust and credibility among teachers. This arose from their willingness to go into schools and help with all types of problems faced by the teachers. The consultants became important members of the SSCC for they provided background information from which important decisions were taken by the Committee.

In summary there were three main structural features of science education in South Australia. First, from 1968 and into the early 1970's, secondary schools experienced difficulty in developing suitable science curricula. Secondly, there was an avenue by which information about these problems could be directed to those who had the power to assist in overcoming them. This was via the cadre of consultants who were in constant contact with science teachers in the schools. Thirdly, there was, in the SSCC, a group which was able to marshall the resources of the system and of the wider educational milieu to provide material assistance to the schools.

In addition to the structural factors discussed above some aspects of the use of curriculum materials in science need to be considered. Whereas, in Queensland, one set of science textbooks had been replaced by another set during the late 1960's, in South Australia teachers were encouraged to introduce a variety of book and non-textbook resources. In the search for appropriate materials which encouraged approaches to teaching which were consistent with the philosophy of outline syllabuses, some South Australian secondary schools used units of the Junior Secondary Science Project (JSSP), the forerunner to ASEP (Trapnall, 1969). Thus, senior teachers and the members of the SSCC had the opportunity to become familiar with materials with similar characteristics to ASEP units. There was also a tendency across the State to use teacher produced individualised programs printed within schools. Many science teachers organised their classes so that students of differing abilities could work with curriculum materials which allowed for differentiated rates of learning. Some of these locally produced materials were of good quality but some were of doubtful educational value, especially when compared with the JSSP units. The stage was set for science educators at the system level to welcome the infusion of further materials similar to those of JSSP.

Links With the Resource : South Australia

As in other States the State Advisory Committee (SAC) acted as the major link with the ASEP development. The committee of 12, which contained representatives from the Education Department, University of Adelaide, and private and government schools met for the first time in May 1970. From the outset SAC (South Australia) was nested within the framework of the SSCC with terms of reference as follows:

(1) to provide information and advice to ASEP as required,

(2) to regularly inform the SSCC on the programs and role of ASEP, and

(3) to inform South Australian teachers on the workings and progress of ASEP. (In time, the SAC (South Australia) will monitor trials and assist in teacher education programs as required.)

(South Australia SSCC Minutes, May 1970:1)

From its inception the SAC (South Australia) supported the development of ASEP within the framework of school based decision making about the curriculum. The second SAC (South Australia) Chairman summarised this in the following way:

> The attitude of the SAC (South Australia) was that we weren't looking at them (ASEP) as a package deal which the State would either want to say or could say in terms of our philosophy, in terms of school-based decision making, that these would be the materials which would be prescribed. But we saw ASEP materials as being simply one, but a very important one of a wide range of materials which would be available for schools to select.[7]
>
> (Cusack, 1977)

The SAC (South Australia) arranged trials of the ASEP materials and the appointment of Mr. R. Arnold, a science consultant, as the trials coordinator. He was free to devote his time and resources to the task. Now the importance of the consultants and their credibility in schools became a key factor in encouraging the use of ASEP in South Australian schools. In 1972 Arnold capitalised on his experience and reputation as a consultant to arrange the National Trials required by ASEP. Only 45 teachers in 45 schools participated but, in accordance with ASEP's directives, these teachers were well briefed before the trials began. Generally, there was a favourable reaction to ASEP from teachers in South Australia, and this was summarised by Arnold in a report to the ASEP development:

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[7] My emphasis.

> ASEP philosophy and guidelines have already had a significant influence on many science teachers involved with junior science programs in S.A. Participation in the National Trials has been a unique and memorable experience for many teachers, schools and students.
>
> The eventual availability of ASEP materials will enrich the 'smorgasbord' of materials that are already available to S.A. teachers.
>
> ASEP philosophy and guidelines will undoubtedly affect the course and quality of science education in S.A. in the future.
>
> (Australian Science Education Project.(COM) Minutes, 21 August 1972.)

Then, during 1973 and 1974, through a comprehensive recirculation of the trials forms of the ASEP units, it was possible for the majority of science teachers in South Australia to become acquainted with the ASEP endeavour. This paved the way for high adoption of the ASEP materials when they were published in their final form.

Thus, extensive use was made in South Australia of social interaction techniques to disseminate knowledge of the ASEP Project to prospective users during the formative stage of the development. This was possible because consultancy procedures had already been set up.. The experience, credibility and freedom of the consultants contributed to their effectiveness in spreading knowledge about the materials.

Factors Affecting Implementation : South Australia

The impact of the ASEP materials in South Australia from 1974 cannot be fully understood without some consideration of two factors. First, through the SSCC, a curriculum guide for science teachers was constructed to aid school based curriculum development. As a consequence ASEP materials became an attractive resource for science teachers. Secondly, through the widely accepted consultancy service teachers gained first hand support for the implementation of courses in science which incorporated contemporary materials and methods.

Consider first the importance of the SSCC. From 1974 it assumed a greater role than before for decision making in science education in South Australia. A sub-committee structure was set up, the membership grew to over 40, and representatives from private schools joined the group.

The SSCC became a forum where teachers and senior members of the Education Department worked together on projects which were subsequently reported to the science teaching community (see, for example: South Australia. Education Department. Secondary Science Curriculum Committee, 1976 b). The SSCCs mode of operation meant that science teachers had a new perspective on curriculum decision making. Furthermore the sub-committee structure enabled inspectors and others in the Education Department of South Australia to monitor decisions and become aware of able people who were eligible for promotion.

One sub-committee formed by the SSCC, to discuss curriculum design, was to have a pronounced influence on the subsequent use of ASEP in schools. In 1974 this group began an ambitious project to provide guidelines by which school based curriculum development in science could be made more effective. The result was 'The Do It Yourself Curriculum Guide' (Best, 1974). The Guide stressed flexibility in curriculum planning and was structured to challenge teachers to review their science courses. In order to disseminate its ideas as widely as possible, a series of conferences was held for Heads of Science Departments where they were able to consider the relevance of ASEP and other materials to their school curricula. These conferences were an inspired act of teacher education. They were directed at those in schools considered to be most influential in decision making relating to the science curriculum.

The Heads of Science Departments and Vice-Principals of schools took part. The Heads of Science Departments were involved because they were the key figures in planning carried out at the subject level. The Vice-Principals were involved because of their overseer role in the school and the necessity for them to be aware of changes which were being planned in science.

The activities of the consulting services during the period from 1974 to 1976 contributed to the continued high adoption and use of ASEP during the period. In science the coordinating consultant position was held by Mr. R. Page who had been involved with the ASEP team for two years. Following the tradition of previous consultants Page had considerable freedom to visit teachers in school science departments throughout the State. His major tasks included: organising meetings of teachers within regions, assisting with the use of the 'Guide' and enabling teachers to become familiar with new textual materials in science. In addition, Page was responsible for a series of newsletters to schools. In all of these activities Page and the other consultants were able to present the ideas and materials of the ASEP development to teachers and to provide maintenance for the ASEP materials during their use.

To recapitulate, the ASEP materials were publicised by influential agencies within the educational medium in South Australia. During the formative stage of the ASEP development, many science teachers either used or saw the materials of the Project. Later, the focus for planning science courses shifted to 'The Do It Yourself Curriculum Guide'. Teachers were encouraged to consider a range of curriculum materials and their usefulness for achieving teaching objectives advocated in the Guide. However it was apparent that the Guide emphasised the ASEP materials and this was the means by which inspectors and advisers in South Australia encouraged the use of ASEP, without appearing to promote one set of curriculum materials over others.

Victoria

The analyses of strategies outlined in the previous chapter showed that, compared with their peers in the other two States, science teachers in Victoria had more opportunities to become familiar with the ASEP development during its formative stage. The analyses also indicated that, after the Project team was disbanded, few linkages such as those between inspectors or advisers and teachers, were forged to assist with the implementation of ASEP ideas and materials. In Victoria there was relatively strong support for ASEP during the dissemination of information and relatively weak support for implementation. To help interpret this intriguing pattern a study of medium level factors was undertaken in a similar fashion to that undertaken for the other two States.

Structural Factors : Victoria

Developments in science education in secondary schools in Victoria need to be considered in conjunction with the changes which took place in the general structure of secondary education. In all three States under consideration one consequence was the devolution of responsibility for most aspects of the curriculum to schools. However, in Victoria this devolution occurred earlier than in Queensland and South Australia. From 1967 on government secondary schools had a considerable degree of autonomy when making decisions about the curriculum at the school level, particularly in the junior secondary school. The only external controls occurred through the requirements of the Year 12 examinations administered by the Victorian Schools and Universities Examination Board (VUSEB).

Early moves to reduce the influence of centralised authority on secondary education in Victoria were initiated in 1966 when the then Director of Secondary Education (Mr. R.A. Reed) set up a Curriculum Advisory Board. The Board examined the structure of the first four years of secondary schooling and established underlying principles for this period of general education (Victorian Secondary Teachers' Association, 1970). Included in the Board's guidelines was one that there should be a core curriculum which included the natural sciences. However, these guidelines had little impact. No move was made to develop priorities to guide schools on the composition of their curriculum. As a result the onus for curriculum decisions was passed to the schools.

During this period of curriculum devolution there developed and continued a conflict between the Education Department and the Victorian Secondary Teachers' Association which represented the majority of secondary teachers in government schools in the State. The documentation of details of the dispute is beyond the scope of this study. However, one result of the difficult relations between teachers and the Education Department was the 'stand off' stance taken by both sides with respect to curriculum matters. Thus school based curriculum planning often took place without the assistance of or advice from agencies based at the system level.

The low level of contact between schools and Departmental advisers affected the planning of science courses based on ASEP, particularly during the implementation stage after the ASEP team had disbanded. However, in the period when the ASEP materials were being developed, there were other contacts which supported the Project.

Links With the Resource : Victoria

The situation regarding linkages in Victoria differed from that in the other two States since the ASEP team was located in Melbourne. There were continual personal contacts between members of the ASEP team, teachers and other science educators during the term of the Project. ASEP's location also affected the relationship between it and the State Advisory Committee of Victoria (SAC (Victoria)). This committee provided information to ASEP and strong support throughout its existence. In fact it met far more regularly than its counterparts in other States and gave a great deal of attention to the ASEP development.

The two factors, the interest and involvement of the SAC (Victoria) in ASEP and the location of ASEP's headquarters led to a high local involvement in the trialling of ASEP materials and inservice education for teachers involved in local trials (Moritz, 1975). The SAC (Victoria) also became: (1) concerned about the need for science subject coordinators to receive guidance about ASEP (Minutes of SAC (Victoria), 26 May 1970), (2) involved in the National Trials of the ASEP materials, and (3) perturbed about the needs of teachers who would use the ASEP units should the development team disband (ASEP Document File, Document 24, 4 October 1971). In 1973, when it became obvious that the ASEP team would break up, the SAC (Victoria) organised a series of one-day inservice courses intended to introduce Heads of Science Departments to the ASEP units.[1] However, due to the lack of time, these conferences focussed on technical issues rather than on underlying principles of the ASEP development.

In November 1973 there was a large scale one-day ASEP conference open to all Victorian teachers of science. About 430 attended to work with the ASEP materials under the guidance of experienced teachers who had taken part in the Trials. By the end of 1973 the effects of inservice courses were such that a high proportion of Victorian science teachers had some knowledge of the ASEP development. But, apart from those involved in the Trials, few teachers had the chance to come to grips with the details of the ASEP philosophy through inservice ASEP courses. The extent to which ASEP principles were understood by teachers depended on the activities which took place in the Victorian system after the ASEP team disbanded.

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[1] Mr. D.J. Harkin was the trials coordinator in Victoria.

Factors Affecting Implementation : Victoria

The description of the pattern of adoption of ASEP materials presented earlier in the chapter showed that few schools in Victoria adopted sufficient ASEP materials on which to base an entire science program. Further, there was a large reduction in the extent of adoption across the State over time. These were indications that ASEP ideas and materials had not had a major impact on school programs at the State level. From a comparison of medium level effects in the other two States, two major factors emerged as possible explanations for this situation. First, no curriculum framework existed in Victoria upon which science teachers could base decisions regarding the planning and execution of science programs in the schools. Secondly, there was no coordinated centrally organised network to introduce and support new methods of science teaching in schools.

With respect to the first feature, it is appropriate to compare Victoria with Queensland and South Australia where curriculum frameworks were in existence. By contrast, in Victoria, teachers in each school had to determine what science they would teach, and why, and what resources they would employ. With respect to the second feature it is essential to note that, although ASEP inservice courses were conducted in Victoria, there was no coordinating body directing these efforts. Thirty one-day ASEP workshops held in 1974 were sponsored by the SAC (Victoria) in conjunction with the national Curriculum Development Centre. In addition other groups, such as the Victorian Universities and Schools Examination Board's Science Committee and the Science Teachers' Association of Victoria (STAV), offered courses concerned with ASEP.

However, a major problem for science teachers concerned the reanalysis of existing school science programs in view of recent developments in secondary education, particularly the need to consider the role of science in the general education of children. Teachers also needed to consider the advantages and disadvantages of new curriculum resources in the light of this reanalysis. Few inservice programs in Victoria approached the ASEP materials from this viewpoint; this was in contrast to the tactics adopted in South Australia.

The problems of curriculum planning in government secondary schools were exacerbated by the unavailability of consultancy services for teachers to help solve the day-to-day problems of implementation of science courses based on the use of ASEP or similar materials. Unlike the situation in South Australia, consultancy services had not been available to schools in Victoria. In fact,there were no consultants in 1974 and in 1975 only two of the eleven Education Department regions employed them. Not until 1976 were science consultants appointed to each educational region.

Concluding Comments

This chapter has dealt with factors affecting the support given to ASEP in three Australian States. In order to provide a full and rich picture of influential features an historical account, derived from a variety of resources, was presented dealing with structural factors, links with the resource and factors affecting implementation. The account reveals three different 'profiles' for each State. Each one showed how the educational medium supported changes in science education, and how ASEP was promoted as a resource for new science programs in schools. The discussions in the ensuing two chapters must be considered against the diorama presented in this and the preceding chapters.

CHAPTER NINE

TYPOLOGIES OF SCHOOLS

Introduction

The focus of the report now moves to the users, the science departments in the schools, and to an analysis of the implementation of ASEP ideas and materials in science programs. Consideration is also given to the determinants of implementation. This is based on the paradigm presented in chapter Four where implementation was linked to: (1) the commitment of a science department to ASEP in terms of adoption and reported use of the materials, and (2) the Innovation Climate in a science department. Commitment was taken to be measured by the extent to which the ASEP materials were in the school and used in classrooms. However, the degree to which the science program was actually based on the rationale of the ASEP development depended, according to the paradigm, on the Innovation Climate; the combined ability of the teachers to accept new knowledge and build a curriculum based on this knowledge.

Analysis of user effects was carried out in two mutually dependent stages. In the first, outlined in this chapter, use was made of data collected from all schools in the three State samples. Multivariate statistical procedures were used to help categorise schools in terms of their commitment to ASEP and their Innovation Climate. Also, the categorisation of schools permitted certain "typical" schools to be selected for more intensive study. The results of these intensive examinations are given in chapter Ten.

State Level Data Analyses

The multivariate techniques used were cluster analysis and discriminant function analysis. These methods were considered appropriate for the determination of typologies of school science departments in terms of their commitment to ASEP and their Innovation Climate. The cluster analysis grouped schools with similar profiles on these two factors in each State and the discriminant analysis assisted with the description of the nature of these groups.

Before data analysis was carried out a careful review was made of cluster techniques and the meaning attached to a cluster in order to select the most appropriate technique for the study. A cluster can be considered as a continuous region of space where there is a high density of points (Everitt, 1974). Cluster space is defined by the variables used in the analysis such that each of the variables is represented by one of the axes of the space.

Now, although clustering or grouping of entities has been used in research in the social sciences for some time and the various methods of clustering have been comprehensively reviewed (Jardine and Sibson, 1968; Williams et al, 1971), no firm conclusions are available on the most valid methods of treating raw data so that the groups formed are the best reflection of the natural grouping. It was decided, therefore, to follow general educational practice and to use a method of hierarchical clustering where each successive assembly of groups is dependent on the constitution of those already formed. Ward's (1963) approach was adopted to classify entities (in this case, schools). In this method an indicator of success of grouping is an estimate of the loss of information which occurs from the clustering at each step in the analysis. This estimate is formed by calculating the total sum of squared differences from the mean values for all variables for all schools within each cluster, and summing over all clusters. The original number of clusters is progressively reduced from the number of entities in the sample until all have been classified into one of two groups. At each step in the reduction the total within-groups variance is considered. The next amalgamation is that which results in the minimum increases in the within-groups variance:

> This procedure is a compromise with the theoretical idea of optimum grouping .... since at each stage of the process the previous grouping is accepted as the basis for determining the next reduction. One can imagine this process leading gradually to a solution which is not optimum, but only under circumstances where the 'neutral' clustering of the objects profile is quite weak.
>
> (Veldmann, 1967:309)

In this study clustering was carried out on data collected from school science departments within States, rather than across States. This decision was made after considering evidence which showed that there were marked differences between the States, not only in the average commitment to ASEP by schools, but also in a variety of other system level factors affecting the organisation of schools. An important question was whether, given these differences, similar clusters existed in each State.

Choice of Variables

Details of the variables used in the analyses are provided in chapter Five. The unit of analysis was the science department in a school and this necessitated an aggregation of teacher responses on some of the variables. These included measures of the use of ASEP at each year level and measures on each of the five scales which constituted the Innovation Climate.[1] Detailed information on all variables is outlined in appendix 9/1.

Before carrying out clustering procedures two preliminary computations were made. The first was a factor analysis of the variables which described the adoption and use of ASEP in the school. According to Everitt (1974) this step should be taken as the procedure "stabilises" the variables finally used if underlying factors are shown to be present. Also, there is a consequent reduction in the number of variables describing the commitment to ASEP in schools which makes the ratio between types of variables approximately identical. That is, there are approximately equal numbers of variables describing the commitment to ASEP and the Innovation Climate. This was a desirable condition because the grouping technique treats each variable as being of equal importance.[2] The second preliminary computation was the standardisation of all variables. This procedure "equalises" all measures used in the clustering technique and if not carried out variables with smaller variances would contribute less to the measure of between-group distances.

In addition, the form of the clustering variables was also affected by the requirements of the discriminant function analysis which was used to describe the characteristics of the terminal groups. If multivariate analyses of the type of which multiple discriminant analysis is a member are used it is necessary to combat the bias that can occur in the interpretation of the results through the ratio cases:variables being too small. The bias occurs when extrapolating the results of a sample to that of the population from which it is drawn. As yet no statistical tests are available to determine the appropriate ratios. Cattell (1952) suggested that a four to one ratio of cases:variables was the minimum allowable for factor analysis. For discriminant function analysis the advice of Tatsuoka (1970) was that total sample size should be at least two and preferably three times the number of variables. Rummel (1970), in commenting on the lack of research on significance tests for these purposes, stated that numbers of cases to variables should be as large as possible.

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[1] The SPSS Program AGGREGATE was used in this phase of the study.

[2] The Program H-GROUP was used to perform cluster analysis (Veldmann, 1967:311).

The factor analyses reduced the number of variables used in the subsequent cluster and discriminant analyses. The ratio of cases:variables became approximately seven to one and this appeared to be acceptable given the opinions stated above.

Selection of "Terminal" Groups

In general, as the number of groups becomes less during the clustering procedure, the total within-groups variance rises. This is due to the increasing dissimilarity in the profiles of schools within each group. A judgement must be made concerning the level at which no further breakdown into smaller numbers of groups is allowed because there is no statistical test to assist in the decision. However:

> examination of the errors associated with successive stages of the grouping process will usually reveal a particular level (number of groups) that is especially worthy of study, since reduction to the next stage could involve a substantially larger increase in error than had been associated with previous reductions.
>
> (Veldmann, 1967:311)

This advice was followed in this study to select the final or terminal groups.

Significant Differences Between Terminal Groups

The identification of the salient features of the clusters formed was carried out in two ways. First, the importance of each of the variables in distinguishing between the terminal groups was determined by examination of one-way analyses of variance and noting those with significant F values; a value of 0.05 was set as the significance level acceptable.

Secondly, as a check on the nature of the terminal groups which allowed for the possibility of significant intercorrelations between the variables, a multiple discriminant function analysis was carried out. This form of analysis considers the best linear combination of the variables which cause maximum separation between the groups (Tatsuoka, 1970). Theoretically, if there are N groups there can be N-1 independent discriminant functions. In practice the number of significant functions is almost always smaller. Huberty (1975) has suggested that there are four major uses for discriminant function analysis. These are: separation, determining significant differences between the centroids of groups; discrimination, studying the effects of the variables on group separation and the description of groups; estimation, relating the variables to the distance between groups; and classification, creating rules for the allocation of individuals to previously defined groups.

In this study, the major purposes of each linear discriminant analysis were to describe the groups formed and to discriminate between groups. The discriminant analysis also enabled the school most typical of each group within each State to be identified through comparison of the values of each school on the discriminant functions. The schools identified by this procedure were those selected subsequently for more intensive case study. Thus, from this research, a fifth use of discriminant analysis has occurred, namely identification.

Other characteristics of the discriminant technique are specified in later sections dealing with State results.

Innovation Climate Scales

Before any grouping of schools took place the statistics related to the Innovation Climate were reconsidered. Scales which constituted the Innovation Climate of a science department in a school, which had been checked at the national level (see chapter Five) were examined at the State level and are listed in Table 9.1. The item statistics were similar to the national level values and were considered adequate for purposes of this exploratory study when judged against the criteria adopted by Nunnally (1967) and Gardner (1975). The reliabilities were particularly acceptable in view of the fact that the science department rather than the teacher was to be the unit of analysis.

Computations were also made on the extent to which science teachers in each school had similar views about the Innovation Climate in the science department of which they were members. These were based on a suggestion by Lewis (1976). A ratio, which indicates the proportion of total variance on each scale which could be explained by school effects (eta squared), was calculated for the cases within each State. The ratios, reported in Table 9.2, provided a measure of the agreement of teachers in each school on the five scales. Between 15 and 52 percent of the total variation was due to between-school effects.

Table 9.1 Innovation Climate Scale Statistics : Between Teachers

	Scale				
	Organisation	Cooperation	Openness	Interaction	Knowledge of the Innovation
Number of Items	7	6	6	7	8
Possible Score	35	30	30	35	8
α Reliability					
VIC	0.69	0.65	0.63	0.69	0.65
QLD	0.66	0.73	0.64	0.65	0.64
SA	0.63	0.65	0.68	0.73	0.60
Mean					
VIC	21.7	19.4	21.9	12.4	5.5
QLD	22.2	20.0	21.8	12.7	5.3
SA	23.4	19.2	21.9	13.7	5.5
Standard Deviation					
VIC	5.0	4.1	3.2	4.9	1.9
QLD	4.5	4.6	2.7	5.2	2.1
SA	4.1	4.0	3.2	5.9	2.5

Note: Number of Cases: VIC (N=220), QLD (N=277), SA (N=273)

Table 9.2 Values of Eta-Squared for Innovation Climate Scales

Scale	Eta-Squared		
	VIC	QLD	SA
Organisation	0.52	0.48	0.41
Cooperation	0.38	0.52	0.33
Openness	0.21	0.24	0.15
Interaction	0.25	0.18	0.17
Knowledge of the Innovation	0.27	0.19	0.22

The figures in Table 9.2 were interpreted as indicating that Organisation and Cooperation were particularly "strong" school variables in all States. There were greater variations between science teachers irrespective of the school in which they worked on the other three measures.

Values of eta-squared also enable conclusions to be drawn regarding the extent to which the Innovation Climate was associated with each school. When consistently high values appear in the columns of Table 9.2, it indicates that school conditions affect the Innovation Climate, rather than them being due to a general effect within a State. The figures imply that there was more a "school effect" in Victoria than in the other two States. This is consistent with information displayed in chapter Eight, where it was shown that, in Victoria, local rather than medium level factors were particularly important in determining the nature of the science curriculum.

Victoria

The Preliminary Factor Analysis

Table 9.3 records the results of the preliminary factor analysis for schools in Victoria, using the variables associated with the adoption and use of ASEP module packs.[3] Using the Kaiser criterion (Child, 1970), only factors with eigenvalues greater than unity were selected for further study. The first two factors fulfilled that condition and explained almost two-thirds of the total variance. The principal components procedure was followed by a varimax rotation.

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[3] The SPSS Program FACTOR was used. The method employs Principal Factoring with iteration, based on the assumption that each variable contained a unique element not explained by the factors extracted.

Table 9.3 Preliminary Factor Analysis : Victoria
Varimax Solution (N=43)

Factor	Eigenvalue	Percentage of Variance	Cumulative Percentage
1	3.81	47.6	47.6
2	1.31	16.4	64.0
3	0.91	11.4	75.4
4	0.76	9.5	84.9
5	0.47	5.9	90.8
6	0.33	4.1	95.0
7	0.25	3.2	98.1
8	0.15	1.9	100.0

Variable	Rotated Factor Loadings		
	I	II	h^2
ASEP Use Year 7, 1975	81		73
ASEP Use Year 8, 1975	69		71
ASEP Use Year 9, 1975	76		58
ASEP Use Year 10, 1975	62	43	58
Modules Adopted 1974	52		35
Modules Adopted 1975	58		47
Modules Adopted 1976		75	38
Date of First Use	75		52
Percentage of Variance	48	16	64

Note: Decimal points omitted in the lower section of the Table.
Only factor loadings greater than 0.30 are included.

Six of the eight variables loaded uniquely on the first factor and one variable loaded uniquely on the second. The variable 'ASEP Use in Year 10, 1975' had significant loadings on both factors. Two options were open to deal with this dual loading. The variable could be deleted from subsequent analyses thereby retaining the orthogonality of the scales but reducing the amount of information which contributes to these scales. Alternatively, the variable could be retained, but then there would be some overlap between the two composite scales. The information available about Factor I suggested that schools which loaded highly on this factor were committed to ASEP from the first availability of the materials, and that use took place throughout the school science program. The information about Factor II suggested that schools which loaded heavily on it used ASEP heavily in Year 10 and planned further purchases of ASEP in 1976. These logical interpretations of the factors implied that 'ASEP Use in Year 10, 1975' properly belonged to both scales and so it was decided to retain the variable on both factors. They were labelled 'Early Adoption and Use' and 'Later Adoption and Use' respectively.

The Cluster Analysis

Hierarchical cluster analysis was undertaken using the two variables identified in the factor analysis and the five measures of Innovation Climate. Table 9.4 lists the increase in within-groups variance for the sample of schools in Victoria. The Table shows that a relatively large increase in within-group variance occurred when the number of groups was reduced from four to three. Thus four groups were selected as clusters for study; they are referred to as terminal groups in subsequent discussion.

Table 9.4 Increase in Within-Group Variance with Successive Combinations in H-Group Analysis : Victoria (N=43)

Number of Groups	Within-Group Analysis
43	0
21	3.2
10	9.8
8	12.3
7	13.5
6	16.3
5	18.6
4	18.9
3	23.5
2	37.6

The seven group variable means were compared between clusters using a one way analysis of variance. Table 9.5 shows the respective group means for each variable and indicates where there were significant differences between groups.[4]

The Linear Discriminant Function Analysis

The nature of the terminal groups was next determined by a linear discriminant function analysis (LDF).[5] In this method variations between groups on a given set of variables are determined by the formation of a weighted linear combination of variables. This linear combination is such as to maximise the difference between the groups. An investigation of the weights used to create the LDF assists in the analysis of the characteristics of the groups and in determining differences between groups.

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[4] Veldmann (1967) cautions that the F values can be artificially high because of the nature of the grouping process. In this chapter the F values were used simply to determine the relative importance of the variables in distinguishing between the groups.

[5] The SPSS Program DISCRIM was used.

Table 9.5 Groups Means of Variables for the Terminal Clusters : Victoria (N=43)

Variable	Group				Sig
	I (N=12)	II (N=18)	III (N=5)	IV (N=8)	
Early Adoption and Use	-88	08	-32	135	< .01
Later Adoption and Use	-58	07	-55	105	< .01
Organisation	05	-57	101	56	< .01
Cooperation	-28	-36	90	68	< .01
Openness	-55	-15	-10	122	< .01
Interaction	25	-49	-11	79	< .05
Knowledge of the Innovation	-124	50	46	41	< .01

Note: All variables are standardised across schools. Decimal points omitted.

There are several statistical tests available to assist in decisions about the relative importance of LDF's which lead to their retention or deletion in further analysis. In this study Wilks Lambda(Λ) was calculated (Cooley and Lohnes, 1962) and transformed to a chi-squared statistic to test for significance (Bartlett, 1947). The Wilks Lambda is an inverse measure of the discriminating power of the variables which have not been removed by each LDF. The smaller the value of Lambda the greater is the amount of information remaining. Because group membership had already been determined by the cluster analysis a high level of significance (p <.001) was set in order to decide whether each LDF was to be retained for examination. A second statistic, the canonical correlation, was used to measure the ability of each LDF function to discriminate between the groups. The square of the canonical correlation is the proportion of variance of the LDF explained by the groups (Klecka, 1975).

To aid in the interpretation of the LDF's structure coefficients, which are the correlations between an LDF and each of its constituent variables, were used. They were preferred to transformation weights. Transformation weights are those weights assigned to the original variables in creating the LDF as a linear combination of the variables and are thus analogous to beta weights in multiple regression analysis. The choice of structure coefficients was made after consideration of the advice of Tatsuoka (1973):

> ... that (the use of structure coefficients) is the more reasonable approach in attempting to interpret canonical factors (as against assessing the relative contribution of each original variable to the factors) becomes obvious when we recall that the standardised weights (canonical or discriminant) are partial coefficients with the effects of other variables removed or controlled. This is fine when the purpose is to gauge the contribution of each variable in the company of others, but is inappropriate when we wish to give substantive interpretations.
>
> (p280)

The results of the discriminant analysis for Victoria are shown in Table 9.6. Note that the eigenvalue, which is a measure of the relative importance of each function, was converted to a percentage of trace.

Table 9.6 Discriminant Function Analysis : Victoria (N=42)

Number of Factors Removed	Eigenvalue	% of Trace	Functions Derived	Λ	χ^2	NDF	Sig
			0	.058	106.1	21	$< .001$
1	3.66	66.6	1	.275	48.4	12	$< .001$
2	1.14	20.7	2	.589	19.8	5	$< .01$
3	0.70	12.7					

About 87 percent of the trace was accounted for by the first two LDF's and, given the non-significant value chi-squared after these two functions had been derived, the third was omitted from further analysis.

The structure coefficients used to interpret the LDF's for the Victorian sample are listed in Table 9.7, from which the following analysis of their values descriptions of the LDF's was compiled:

> LDF 1 (Victoria) categorises a dimension characterised by a commitment to and knowledge of the innovation associated with a willingness to seek out and use new ideas in teaching by the users.
>
> LDF 2 (Victoria) categorises a dimension characterised by order consistent with a well organised user group in which there is collegial professionalism among those in the group.

Among the LDF 1 (Victoria) factors there was a high correlation between Openness and the 'commitment to ASEP', indicated by the two scales measuring extent of adoption and use of ASEP. This was interpreted to imply that the decision to adopt and use ASEP was associated with the intrinsic attitude of science teachers towards change. There was negligible correlation between Interaction and 'commitment to ASEP' scales, and this was taken to imply that contacts between system level agents and schools were unimportant in the dissemination of ASEP materials. This interpretation is consistent with the discussion in the previous two chapters where it was noted that few strategies were available in Victoria to assist schools in adopting and using materials based on recent developments in science education.

Table 9.7 Structure Coefficients and Group Centroids : Victoria

Structure Coefficients

	Function	
	1	2
Early Adoption and Use	0.82	0.20
Later Adoption and Use	0.58	0.16
Organisation	0.09	0.64
Cooperation	0.21	0.46
Openness	0.61	0.39
Interaction	0.01	0.61
Knowledge of the Innovation	0.77	- 0.25
Canonical Correlation	0.89	0.73

Group Centroids

Group		
I	- 2.63	0.63
II	0.50	- 1.14
III	0.29	0.35
IV	2.62	1.41

Group Descriptions

The nature of the terminal groups for Victoria can be described by considering the nature of the LDF's, the position of each group with respect to each LDF, and the respective mean scale scores of each group. The relevant information appears in Tables 9.5 and 9.7 (see appendices 9/1 to 9/4).

The four terminal groups were designated as follows:

Group I (N=12) Dissonant Innovators and Users This group was characterised by low or no use of ASEP and was associated with a lack of desire amongst the staff to try new ideas or materials in their teaching. The staff reported a moderate organisational climate which suggested that groups of science teachers were content with the status quo regarding the ways science was taught within the school.

Group II (N=18) Low Innovative Average Users These schools had purchased ASEP materials but there was no strong inclination to use them throughout the science program. In the science departments of these schools there was a low organisational climate which was associated with lack of cooperation between staff, who rated low on their willingness to be linked with outside agencies and on their attitude to educational change.

Group III (N=5) Moderately Innovative Low Users This group was characterised by below average commitment to the innovation and low linkage of the staff to agencies which promoted change. The other feature of this group was the highly ordered internal structure of the science departments in terms of cooperation between teachers and the adequacy of the facilities for teaching and the efficient use of these amenities.

Group IV (N=8) Above Average Innovative Users Schools in this group were highly committed to ASEP materials and the science teachers were professionally orientated in terms of their attitude to change and their links to sources of information about science teaching. Within the schools the science departments were well organised and the staff had a highly developed concern to assist each other in the execution of their teaching duties.

Queensland

The Preliminary Factor Analysis

The procedures used for the Victorian data were also applied to the Queensland sample and so a detailed description of the methodology will not be repeated.

Table 9.8 Preliminary Factor Analysis : Queensland

Varimax Solution (N=48)

Factor	Eigenvalue	Percentage of Variance	Cumulative Percentage
1	3.87	55.3	55.3
2	0.89	12.7	68.0
3	0.68	9.8	77.8
4	0.66	9.4	87.2
5	0.50	7.1	94.3
6	0.28	4.0	98.3
7	0.12	1.7	100.0

Variable	Rotated Factor Loadings 1	h^2
ASEP Use Year 8, 1975	73	69
ASEP Use Year 9, 1975	74	64
ASEP Use Year 10, 1975	64	52
Modules Adopted, 1974	81	71
Modules Adopted, 1975	54	57
Modules Adopted, 1976	53	38
Date of First Use	82	65
Percent of Variance	55	55

Note: Decimal points omitted in the lower section of the Table.

The results of the principal components analysis followed by a varimax rotation are given in Table 9.8. In this case only one factor, accounting for 55 percent of the total variance, had an eigenvalue greater than one. The factor represented a dimension of general purchase and use and was labelled 'Adoption and Use of ASEP'.

Table 9.9 Increase in Within-Group Variance
Variance With Successive Combinations in H-Group Analysis :
Queensland (N=48)

Number of Groups	Within-Group Variance
48	0
24	2.5
12	5.2
10	7.5
8	11.2
7	12.6
6	12.9
5	22.1
4	24.7
3	25.1
2	29.2

The Cluster Analysis

The cluster analysis for Queensland was carried out using the variable identified in the factor analysis and the five measures of Innovation Climate. Table 9.9 lists the increase in within-groups variance for the sample of schools in Queensland. A relatively large increase in within-groups variance occurred with the reduction in the number of groups from six to five and so six groups were selected as terminal clusters. One 'group' was made up of one school only. Subsequently, it was found that there were missing data on one of the variables for this school; this was the reason for it being outstanding in the clustering. This group was omitted from the subsequent analysis and thus five groups remained.

Table 9.10 Groups Means of Variables for the Terminal Clusters : Queensland (N=48)

Variable	Group					Sig
	IA[a] (N=7)	IB (N=13)	II (N=12)	III (N=12)	IV (N=3)	
Adoption and use of ASEP	-56	-46	42	-31	288	<.01
Organisation	-97	-17	-50	114	44	<.01
Cooperation	-157	-12	-38	43	122	<.01
Openness	-52	-82	55	63	04	<.01
Interaction	-84	-61	70	32	50	<.05
Knowledge of the Innovation	-65	-34	-09	70	54	<.01

Note: All variables are standardised across schools. Decimal points omitted.

Data from one school deleted.

[a] Two groups were labelled IA and IB to facilitate across-State comparisons in later sections of this report.

The mean values of each variable for each group are recorded in Table 9.10. All variables contributed to the difference between the clusters, as indicated by the significance of the F-values in the one-way analysis of variance.

The Linear Discriminant Function Analysis

The results of the LDF analysis for the Queensland sample are outlined in Table 9.11. Two LDF's explained approximately 80 percent of the total variance between the groups and these were retained to describe group differences.

Table 9.11 *Discriminant Function Analysis : Queensland (N=48)*

Number of Factors Removed	Eigenvalue	% of Trace	Functions Derived	Λ	X^2	NDF	Sig
			0	.019	164.3	24	<.001
1	4.59	54.8	1	.107	92.9	15	<.001
2	2.06	24.6	2	.327	46.4	8	<.01
3	1.05	18.0	3	.819	8.3	3	<.05
4	0.22	2.6					

The structure coefficients and group centroids for the Queensland analysis are shown in Table 9.12. Compared with similar data in Victoria interpretation of the functions was more complex because there were relatively high correlations between both functions and their constituent variables in several instances. A major difference between Functions One and Two lay in the contribution of the variable describing adoption and use of ASEP which loaded highly on Function One and negatively on Function Two.

From the results of the analysis the following descriptions of the LDF's for Queensland were developed:

> LDF 1 (Queensland) categorises a dimension described by a commitment to the innovation which was related to a general climate for innovation amongst the users.
>
> LDF 2 (Queensland) categorises a dimension described by an innovation potential associated with the school's climate for innovation; a potential which had not yet been realised since there is little innovation adoption.

Group Descriptions

The characteristics of the terminal groups for Queensland were described after considering the nature of the LDF's, the position of

Table 9.12 Structure Coefficients and Group Centroids : Queensland

Structure Coefficients

	Function	
	1	2
Adoption and Use of ASEP	0.81	-0.31
Organisation	0.38	0.72
Cooperation	0.66	0.22
Openness	0.24	0.55
Interaction	0.41	0.34
Knowledge of the Innovation	0.33	0.48
Canonical Correlation	0.91	0.82

Group Centroids

IA	-3.19	-1.13
IB	-0.33	-0.84
II	0.34	-0.13
III	0.31	2.18
IV	6.26	-1.93

each terminal group with respect to the axes representing each LDF and the respective scale means for each group. The relevant information appears in Tables 9.10 and 9.12.

The characteristics of the five terminal groups were designated as follows:

Group IA (N=7) Dissonant Innovators and Users This group was characterised by those schools which ranked low in their adoption and use of ASEP, and in their cooperation between members of the science staff. Furthermore the science staff generally rated low in the extent to which they believed the school's science resources were adequate for effective teaching, in their willingness to be helped, in their susceptibility and attitude to educational change, and in their knowledge of the ASEP innovation.

Group IB (N=13) Moderately Dissonant Innovators and Users The schools in this group had similar characteristics to those in Group IA, but not quite to the same degree. They were below average in their adoption and use of ASEP and in the extent to which the members of the science staff cooperated with each other. Furthermore their science staffs were below average in their opinions of the school's resources, willingness to be helped, susceptibility to change and knowledge of ASEP.

Group II (N=12) Low Innovative Above Average Users This group was characterised by schools which, contrary to the two preceding clusters, ranked above average in their adoption and use of ASEP materials. But, in common with the preceding two clusters, there was low cooperation between members of the science department who also rated as below average the quality of the school's resources for teaching science. On the other hand the staff were willing to be helped and highly linked to professional contacts outside the school.

Group III (N=12) Innovative Low Users These were schools which, though they ranked above average in their cooperation between members of the science staff, were below average in their use of ASEP. However, teachers of science in these schools believed they had good resources for science teaching, were very willing to be helped, had a favourable attitude to educational change as well as having an above average knowledge about ASEP.

Group IV (N=3) Above Average Innovative Users The few schools in this group were characterised by a high use of ASEP as well as an above average extent of cooperation between the members of the science staff. However, although their science staffs rated as above average in their knowledge of ASEP, opinions of existing resources, willingness to be helped, and attitude and susceptibility to educational change, they were not as high on these three last mentioned features as the schools in Group III.

South Australia

Analyses of the data for South Australia were similar to those used for Victoria and Queensland.

The Preliminary Factor Analysis

The factor analysis of the adoption and use of ASEP measures is presented in Table 9.13. Two factors, accounting for 69 percent of the total variance, had eigenvalues greater than unity.

Table 9.13 Preliminary Factor Analysis : South Australia
Varimax Rotation (N=42)

Factor	Eigenvalue	Percentage of Variance	Cumulative Percentage
1	3.33	47.6	47.6
2	1.47	21.0	68.6
3	0.89	12.6	81.2
4	0.44	6.2	87.5
5	0.37	5.3	92.7
6	0.29	4.1	96.9
7	0.22	3.1	100.0

Variable	Rotated Factor Loadings		Community h^2
ASEP Use Year 8, 1975	83		69
ASEP Use Year 9, 1975	70		56
ASEP Use Year 10, 1975	57	63	62
Modules Adopted, 1974	62		41
Modules Adopted, 1975		84	51
Modules Adopted, 1976		69	44
Date of First Use	50		28
Percentage of Variance	47.6	21.0	

Note: Decimal points omitted in lower section of the Table.
Only factor loadings greater than 0.30 are included.

An examination of the data indicated that these two factors did not correspond to the first two factors extracted in the Victorian analysis (Table 9.3). Although there were some similarities in the buying patterns in Victoria and South Australia, there was also a major difference. This was the variation in the loading of the variable 'Modules Adopted, 1975' in the two patterns. This variable correlated significantly with the first factor in the Victorian analysis and with the second factor in the South Australian analysis. This was taken as an indication of the different adoption patterns of schools in the two States, and an indication that the corresponding factors in the two States' analyses could not be labelled identically. The South Australian factors were labelled 'Early Adoption and Use' and 'Later Adoption and Use' respectively.

The Cluster Analysis

Table 9.14 lists the increase in within-group variance for the sample of schools in South Australia. A large increase in within-group variance occurred with the reduction in the number of groups from five to four and thus five groups were retained but as one of the five groups consisted of one school only it was subsequently deleted from the analyses.

The mean values of each variable for each group are recorded in Table 9.15. All variables, with the exception of 'Later Adoption and Use', contributed significantly to the difference between the four terminal groups.

The Linear Discriminant Function Analysis

The results of the LDF analysis for the South Australian sample are presented in Table 9.16. Two functions accounted for 96 percent of the total variance.

Table 9.14 Increase in Within-Group Variance with Successive Combinations in H-Group Analysis : South Australia (N=42)

Number of Groups	Within-Group Variance
42	0.0
21	3.3
10	7.8
8	10.9
7	14.1
6	16.2
5	18.0
4	23.4
3	25.1
2	32.2

Table 9.15 Group Means of Variables for the Terminal Clusters : South Australia (N=42)

Variable	Group				
	I (N=8)	II (N=11)	III (N=17)	IV (N=5)	Sig
Early Adoption and Use	-75	114	-55	54	< .01
Later Adoption and Use	-48	31	-21	80	NS
Organisation	-40	-41	33	22	< .01
Cooperation	-84	-25	30	87	< .01
Openness	-62	-137	28	87	< .05
Interaction	-74	-22	02	161	< .01
Knowledge of ASEP	-05	87	-69	54	< .01

Table 9.16 Discriminant Function Analysis : South Australia (N=42)

Number of Factors Removed	Eigenvalues	% of Trace	Functions Derived	Λ	χ^2	NDF	Sig
			0	.053	104.0	21	<.001
1	3.76	61.0	1	.254	48.6	12	<.001
2	2.16	35.0	2	.803	7.8	5	NS
3	0.25	4.0					

Table 9.17 Structure Coefficients and Group Centroids : South Australia (N=42)

Structure Coefficients

	Function	
	1	2
Early Adoption and Use	0.87	-0.02
Later Adoption and Use	0.42	0.21
Organisation	-0.13	0.36
Cooperation	0.01	0.66
Openness	0.14	0.48
Interaction	0.30	0.67
Knowledge of the Innovation	0.72	-0.15
Canonical Correlation	0.89	0.83

Group Centroids

I	-1.51	-1.86
II	2.26	-1.08
III	-1.45	0.91
IV	2.39	2.24

Structure coefficients and group centroids are recorded in Table 9.17. The following descriptions of the LDFs were compiled:

> LDF 1 (South Australia) categorises a dimension characterised by a commitment to and knowledge of the innovation associated with a high level of communication between users and resources external to the user group.
>
> LDF 2 (South Australia) categorises a dimension of order consistent with a well organised user group in which there is collegial professionalism among those in the group.

An examination of LDF 1 (South Australia) showed that a strong correlation existed between the variables which measured the commitment of schools to ASEP; Early Adoption and Use, Later Adoption and Use, and Knowledge of the Innovation, and the Interaction scale. There was a low correlation between commitment of schools to ASEP and the Openness scale. The nature of the structure coefficients implies that there is an association, in South Australia, between commitment to ASEP and the extent to which a school science department was linked to resource personnel. This is consistent with the known features of the spread of ASEP in South Australia as outlined in the previous chapter.

Group Descriptions

The characteristics of the terminal groups for South Australia were described after considering the nature of the LDFs, the position of each terminal group with respect to the axes representing each LDF and the respective mean scale scores of each group. The relevant information appears in Tables 9.15 and 9.17.

The characteristics of the four terminal groups were designated as follows:

> Group I (N=8) Dissonant Innovators and Users This group was characterised by those schools which rated low in their adoption and possession of ASEP materials and were clearly below average

in their knowledge of the innovation. Furthermore, the science staff generally rated low in the extent to which they interacted with resource personnel within and beyond the school, and with each other. They rated low in collaboration among themselves, in their willingness to be helped and in their attitude towards and susceptibility to educational change.

Group II (N=11) Low Innovative Above Average Users This group was characterised by schools which, in contrast to those in the preceding group, were well above average in their adoption, use and knowledge of ASEP. However, in many other respects the schools were similar to those in Group I. The members of the science staff rated as below average in the extent to which they interacted with each other and with resource personnel. They were also below average in collaboration among themselves and very low in their willingness to be helped and in their susceptibility and attitude to educational change.

Group III (N=17) Innovative Low Users The schools in this group are comparable to those in Group I in so far as they rated low in their use and adoption of ASEP. However, their knowledge of the innovation ranked below that of the Group I schools. On the other hand the science departments were characterised by adequate organisational arrangements in which staff worked together as a team. The science teachers also rated above average in their willingness to be helped and in their attitude toward and susceptibility to educational change.

Group IV (N=5) Above Average Innovative Users The schools in this group were characterised, not only by an above average knowledge of the ASEP innovation, but by an above average possession and use of the materials throughout all the junior secondary grades. Coupled with this the members of the science staff rated higher than those in any of the other groups on the extent to which they collaborated with each other and interacted with resource personnel within and beyond the school. They were clearly above average in their willingness to be helped and in their susceptibility and attitude toward educational change.

Comparison of School Types Across States

Using the clusters identified in the preceding sections of this chapter, some useful comparisons can be made of the school types across the States. Some inferences can also be drawn on the extent to which the different educational milieux affected the characteristics of the various user groups embedded in each milieu. Comparisons must be made with care and caution since there were some slight differences in the scales used in the clustering. The differences arose as a consequence of the factoring of the seven use and adoption measures. Given the nature of this study and the need to consider as many procedures as possible in order to document the acceptance of the ASEP innovation throughout the nation, the comparisons were attempted.

For convenience of discussion the various terminal groups will be referred to as belonging to four classes of groups as shown in Table 9.18. The name of each class was derived from the descriptions provided in the previous sections, bearing in mind that there were some differences between the groups in each class.

Table 9.18 Classification of Terminal Groups Across States

Class	Description of Class	Groups Allocated to Class		
		VIC	SA	QLD
A	Dissonant Innovators and Users	I	I	IA, IB
B	Low Innovators, Above Average Users	II	II	II
C	Innovative Low Users	III	III	III
D	Above Average Innovative Users	IV	IV	IV

From the data available it was also possible to calculate the proportion of schools in each State which would be categorised into each of the four classes of Table 9.18. This information is given in Table 9.19.

Using the information set out in Tables 9.18 and 9.19 the nature of these classes of schools is now outlined.

Table 9.19 Comparison of Terminal Groups Across States

Class	Class Name	Percentage of Schools in Each Group		
		VIC	QLD	SA
A	Dissonant Innovators and Users	28	41	20
B	Low Innovators, Average or Above Average Users	42	27	27
C	Innovative Low Users	12	27	41
D	Above Average Innovative Users	19	6	12
		100	100	100

Dissonant Innovators and Users : Class A

These schools would be of major concern to those advocates of science courses based on the ideas and materials of the ASEP development. Not only were they schools where teachers rated below average in knowledge and use of ASEP but the science departments were low in the extent to which teachers collaborated with each other, made use of resource personnel, were willing to be helped and to weigh and consider the benefits of educational innovations. The collegial professionalism was very low and, as such, these user groups constitute a challenge for employing authorities to provide the means by which teachers in these schools may enhance their professional growth. In Queensland and South Australia the teachers in these schools also had a low opinion of the adequacy and utilisation of the science teaching resources available to them.

The proportion of schools in this class varied from one in five in South Australia to two schools in five in Queensland. A large number of science departments in secondary schools could consequently be considered to be operating under conditions where the creation and implementation of science courses based on modern trends in science education was unlikely. This is a sobering interpretation since an associated implication is that those pupils taking science in these schools do not profit adequately from their studies because of the quality of the courses offered.

Low Innovators, Average or Above Average Users : Class B

This class of schools is an intriguing one for, although the schools were generally low in their willingness to be helped, below average in their interactions with other science departments, and were low on organisational and collegial aspects, they were average or above average adopters and users of ASEP materials (for their State). It is important to note that there were variations between these groups across States, particularly with respect to their adoption and use of ASEP and on the scales Interaction, Openness and Knowledge of ASEP. The extent of adoption and use, for example, was highest for South Australia, and this could be related to the strong system level support for ASEP. It seems that, as a consequence, schools in that State followed system level advice and adopted ASEP without first being convinced of its rationale.

Significant features of the Queensland schools in this Class were that the scores on the scales Openness and Interaction were far higher than for the comparable terminal clusters in the other two States. This implies that there was a willingness within these user groups in Queensland to try new ideas in their teaching. However school factors, as indicated by low scores on Organisation and Cooperation, acted as barriers to the efficient use of the innovation.

A large fraction of the total number of Australian secondary school science departments; one quarter in Queensland and South Australia and four in ten in Victoria fell into this Class.

Overall, 70 percent of schools in Queensland and Victoria were categorised as being low in their Innovation Climates. About 50 percent can be similarly categorised in South Australia. The results in Victoria and Queensland are not encouraging, especially for those who wish to foster innovations in science. It is tempting to speculate that the lower proportion of below average Innovation Climate schools in South Australia is linked to that State's endeavours with school-based curriculum planning.

Innovative Low Users : Class C

There appears to be considerable similarity between these terminal clusters across States. The Innovation Climate scores were generally above average; a comparison of the measures on the five scales shows that the Interaction scores were relatively low, which implies that links between schools and outside agencies were not strong. The measures in each of the States indicate that the organisation of the science departments and cooperation between teachers were above average. In the case of Queensland and South Australia, teachers in these departments were above average in their willingness to entertain new educational ideas. It is intriguing, therefore, that in these two States, stronger links were not established with resource personnel and with other schools. It is apparent that these schools had a 'conservative' approach to the adoption and use of ASEP which was associated with the lack of contact with system level agents. These features will be discussed again in chapter Ten.

The highest proportion of schools in the States examined was in South Australia with four in ten falling into this category. Victoria had the lowest proportion; about one in ten.

Above Average Innovative Users : Class D

Of all the classes, this was the one where the terminal clusters appeared most similar across States. On most counts the characteristics of these relatively small clusters match. There was high and continued use of the innovation and teachers in the science departments in these schools knew a great deal about it. Other Innovation Climate measures were high. From the point of view of the ASEP developers it is a pity there were not more schools in this Class across Australia. Less than 20 percent of schools in the three States belonged to the category; the proportion in Queensland - six percent - was the lowest.

Concluding Comments

In this chapter a new approach was employed to study the impact of an educational innovation across a nation. The application of cluster and discriminant analysis techniques enabled typologies of schools to be established with an interesting consequence. Even given the distinct differences between States and between their system or State level administrations and their educational milieux, comparable typologies were identified, with minor internal variations. That these comparable typologies occur, especially those designated 'Dissonant Innovators and Users' and 'Low Innovative Above Average Users', present challenges to the separate State education Authorities, bearing in mind that the greater proportion of schools rated low on Climate to Innovate. As Table 9.19 showed, a major difference between the States was in the proportion of schools falling into each Class: comparable typologies of schools occurred across the States.

Using the typologies established in this chapter, schools representative of each typology were selected for more intensive "case study". This was done and the additional perspectives are presented in chapter Ten.

CHAPTER TEN

A DESCRIPTIVE ACCOUNT OF THE INFLUENCE OF ASEP IN SELECTED SCHOOLS

The Selection of Schools for Intensive Study

In this chapter reports, based on visits to selected schools, are presented. These indicate the influence the ideas and materials of the ASEP development had on the conduct of school science curricula. The intensive study of schools was based on the tentative theoretical paradigm outlined in chapter Four, where it was postulated that the extent to which the ideas underlying the ASEP materials would be incorporated into the science curricula of schools depended on two factors. The first was the level of commitment of a school to the ASEP materials in terms of adoption and reported use. The second was the Innovation Climate in the science department using ASEP. It was predicted that, where there was high commitment to ASEP materials and a high Innovation Climate, science courses would rely heavily on the basic ideas underlying the ASEP development. Where commitment to ASEP materials and Innovation Climate were low it was predicted that the ideas underlying the ASEP development would not be incorporated into school science programs.

As specified in earlier sections of this report the schools were not selected in an arbitrary manner. They were chosen on the basis of their location in the terminal clusters described in the previous chapter. Thirteen schools, each close to the group centroid of its cluster, were selected as the best representatives for their cluster. The distribution of these schools over the Classes established in chapter Ten was as follows:

Class A: Dissonant Innovators and Users (Groups I): 4 schools
Class B: Low Innovative Above Average Users (Groups II): 3 schools
Class C: Innovative Low Users (Groups III): 3 schools
Class D: Above Average Innovative Users (Groups IV): 3 schools

Overall four schools representative of each cluster were visited; one in each State. An extra one representative of Group IB was visited in Queensland.

Methods by which data were collected were discussed in chapter Five. The 13 schools were visited on three or four separate occasions for periods of two or three days from early 1976 to mid-1977. During these visits, information was obtained from documents such as syllabuses, timetables and student test papers, through interviews with the Heads of Science Departments, laboratory assistants, school principals and other staff members and through classroom observation. Interviews were recorded on tape and analysed after each visit. A checklist, based on the intentions of the ASEP developers, guided the description of the ways in which ASEP materials were used in classrooms (appendix 5/9).

It was deemed inappropriate to report in detail on all the visits to every school. There are commonalities across the schools in each Class, and so for ease of presentation and in order to highlight key features, detailed accounts of only one school in each Class are given. However, comments are included about simmilarities and differences between the schools within each Class. Each descriptor school was assigned a fictitious name as shown in Table 10.1. Throughout the study all participants, e.g. principals and teachers, were assured that data would remain confidential and would only be presented in a summary manner. It was considered necessary to guarantee this confidentiality to place respondents at ease and to obtain "open" comments about schools and their science departments.

The sections which now follow contain the case study reports for the four descriptor schools.

Table 10.1 Assigned Name and Class of Descriptor Schools

Class to Which School Belongs	Assigned Name
Dissonant Innovators and Users	Delmos
Low Innovative Above Average Users	Cross
Innovative Low Users	Major
Above Average Innovative Users	Kree

A Dissonant Innovator and User : The Triumph of Conservatism

At Delmos High, a representative of the Dissonant Innovators and Users, no ASEP materials were used in the science program. Scores on all scales of the Innovation Climate were well below the State average values. The purposes of the visits were to determine the kinds of teaching that were taking place, how the curriculum in science had evolved, and the factors which contributed to the low opinion teachers had of the organisation within the science department and its propensity for change.

> *Delmos High School, an inner city school of 700 students, had a strong vocational emphasis in many of the programs in the curriculum. However, up to 1975, the science program was not orientated towards the immediate post school needs of students. Rather, the science department adopted a formal approach, in that didactic teaching methods were used in the majority of classes, and the course content was biased towards the study of 'pure' science topics, taught in traditional subject disciplines.*
>
> *In 1974, the science program at Delmos High School was still based on a syllabus prescribed by an external examination board; a board which had been disbanded in the late 1960's. The demise of this board had been heralded in the State as the opportunity for schools to devise their own curricula based on the local conditions and the needs of the students in the schools. The challenge associated with school based curriculum development had not been accepted by the science department at Delmos High School. The science teachers, a majority of whom had been at the school for over five years, seemed content to change the content of their courses and the methods used as little as possible from year to year.*
>
> *This situation was disturbed in 1975 when a new Head of Science (H/S) was appointed to the school. He set out to review the science programs, and as a result made moves to improve the quality and importance of science instruction in the school. After lobbying the Principal and other senior staff, science was*

made compulsory at each year level, whereas previously it had been an elective at Year Ten. Also, the time devoted to science was increased at each year level. The H/S also acquired an unused storeroom and had it converted into a science resource room. Another initiative was the preparation of plans for an enclosure which was designed to involve students in the study and care of animals.

The new H/S had strong views about the organisation and type of subject matter which should be included in a science course. He maintained that science should be taught with its practical applications always in mind, and that its place in the curriculum rested strongly on its unique approach to learning through student activities. To promote the use of laboratories and to encourage other staff to use these facilities, a booking scheme was evolved whereby science teachers could all have access to the two student laboratories available. This was one means by which he hoped to encourage the majority of staff to move away from a bookish approach to teaching science, teaching which had been conducted mainly in conventional classrooms.

However, the H/S encountered problems in his attempts to involve the science staff in new approaches to teaching and to plan courses based on new ideas in science education. The science teachers could be classified in two groups on the basis of their age and experience. One group were those previously alluded to. They represented the 'old guard'. Of the four teachers so described, three had been at the school for over five years and two had spent their working lives at the school. The other group comprised staff who were in their first or second year in schools after their pre-service training courses. Neither group was willing to spend time in working with the H/S in organising a new curriculum, despite his efforts in calling meetings, and in circulating a draft outline of a total science program.

The experienced teachers appeared reluctant to change because it would have meant a complete reanalysis of their own approaches to teaching. One of the teachers in this group admitted that she had not read the literature circulated by the H/S and confessed that she had no knowledge of curriculum materials such as JSSP and ASEP. An impression was gained during the interviews that these teachers were resentful of having been exposed to a new H/S after having had a period in which they had not been asked to consider or modify the courses they taught.

There were three teachers in the group of science staff who had little experience in schools. Two of these three were involved in teaching science as an 'extra'; their commitments were primarily in subject areas other than science. In this situation they were not willing to spend long periods in planning science courses. They were content to be strongly guided by the decisions of the H/S in matters relating to the science curriculum.

In the absence of any significant dialogue between members of the science department, the H/S had pushed on alone with changes. One of the areas where changes were made was in the choice of curriculum *materials. Because of the low reading levels of students, the prescribed textbook, used in the past, was abandoned. The H/S made two major decisions. First, written materials from the school where he was first posted were modified and made available for use. Secondly, units were chosen from the large range of curriculum materials available commercially. The H/S recognised the difficulty in making up his own sequences:*

> *Writing materials takes skill, and I don't have that skill. I, by myself with six or seven other science teachers, some of whom are inexperienced, how are we going to come up anywhere near the quality of those (materials)? What I've got to do is to use all the materials available.*

Late in 1975, a small number of JSSP and other curriculum project materials were purchased by the school. The policy of the H/S was to build up a range of resources and to encourage other teachers to try the materials in some of their classes. At this stage ASEP was considered and rejected as a resource. The H/S commented that:

> *I looked at ASEP, especially the inspection packs, then asked questions to other teachers in other schools. I looked at materials that had been used (in this school) and decided that we had a Year Eight program which was suitable but Years Nine and Ten programs had glaring deficiencies. I took JSSP. I think JSSP is more restrictive than ASEP, less options. I think inexperienced teachers handle it a lot better, but as I said, we will eventually get ASEP.*

During 1976 first use was made of JSSP. The Year Nine program topics reflected the contents of JSSP courses. One of the more experienced science teachers found that pupils were eager to work alone and was pleasantly surprised at this reaction. This teacher had trialled the ASEP unit 'Solar Energy' in another school with 45 students, found it a difficult unit for students to handle and had taken a set against activity-based courses. A young teacher also found that students were keen to work, and that she was free to attend to weaker students. She planned to tackle more activity-based courses during the year. A third teacher, with only limited training in the sciences, felt that the curriculum project materials were suitably straightforward for the students she taught. By splitting classes into two, and using the resource centre and the laboratory at the same time, she evolved a system which she considered was more suitable for teaching science. While half of the students receive extra attention in the laboratory, the other half were set reference work and assignments from the resources.

In 1977, teachers who had experimented with the activity centred units in the program generally persisted with the use of the materials. However, some staff continued to be reluctant to change their traditional approaches to teaching. An inspection of the booking system for laboratory use showed that the percentage of classes held in laboratories remained at the 1976 level. Only about ten percent

> *of all science classes were conducted in the laboratories. An impression gained during the visit was that the H/S had achieved about as much change as was possible in the circumstances. In this situation, ASEP materials were still considered as inappropriate resources and no units had been purchased by the school.*

At Delmos High School, the lack of openness and linkage to outside agents was consistent with the attitude of a large influential group of teachers who were not disposed towards change. This resulted in a lack of knowledge of new developments in science education, including a knowledge of curriculum materials. In the day to day affairs of the department, there was a lack of cohesiveness among teachers, with different sub-groups going about their work virtually independent of other sub-groups. Although the H/S had initiated changes which appeared to improve the organisation of the department, it was apparent that not all teachers shared this view. There was a reaction to the increased demands placed on teachers to use a wider range of materials, to plan in advance by booking laboratories and to use a greater variety of facilities. For teachers accustomed to working with one textbook in one conventional classroom, such changes required attention to teaching tasks which had not been necessary before the advent of the H/S.

A Low Innovative, Above Average User : Implementation a Failure

Whereas no ASEP units were used at Delmos High School, analyses showed that Cross High School had purchased large numbers during their first year of availability. At Cross High School, ASEP was seen to be the answer to the chronic problem of planning and executing a science program. However, due to factors such as instability of leadership, inadequate laboratory help and teacher inexperience, the implementation of a program based heavily on ASEP encountered many difficulties.

Cross High School was a school for girls situated in the suburbs of a capital city. It had an enrolment of 500 students, all of whom studied science. In Years 11 and 12 about 80 percent of students studied biology but, in common with other secondary girls' schools, very few students took chemistry or physics at these senior levels.

Indicators of Implementation The school purchased over 50 module packs of ASEP materials in 1974, in addition to the appropriate inspection (teachers') packs and student record books. In 1975, many of these units were used in science classes. The extent of use of ASEP materials was reduced in 1976 following unfavourable reactions by most members of staff.

The ASEP philosophy appeared to have had little lasting effect on the way science teaching was carried out at Cross High School. In 1976 and 1977 most of the ASEP materials were left unused on shelves in a storeroom. When the materials were used, teachers seemed ill-prepared and unable to arrange effective teaching sequences. Two examples of classroom activities illustrate these points. In the first, students were working on an ASEP unit designed to introduce techniques of measurement. The unit was placed in an inappropriate position in a series of topics. Rather than preceding the study of mechanics, electricity, light and heat, it was the final unit in this sequence. In the class, students were given a brief introduction and then set to work to answer questions about the core material. The teacher gave instructions that answers were to be written in pencil, so that they could be easily erased before the next class. The students proceeded to write answers in the student textbooks rather than in the record books. From his comments after the class, it was apparent that the teacher, who had been working at the school for three months, was unaware that record books existed and that they were available in the school.

In the second, students were studying the ASEP unit 'Mice and Men'. Few instructions were given to students at the beginning of the lesson. Students embarked on various options, and although the girls enjoyed playing with the mice, the impression gained was that the students made little progress on the option they had selected. There were signs that little forethought had gone into planning the lesson. Apparatus, student texts and record books were not available at its commencement causing delays in starting student activities. During the class, many students found difficulty in drawing graphs, but no attempt was made by the teacher to bring students with this common problem together. One group of students went ahead with an option designed to measure the increase in weight of a pregnant mouse using a male of the species. Throughout, the teacher sat on a desk and was besieged by students clamouring for help. Others worked on without assistance, many spent the lesson playing with the animals. Afterwards the teacher expressed dissatisfaction with the use of ASEP materials. He said:

> *First and second year students haven't got the confidence to take an experiment from beginning to end and then draw a conclusion from it. They have to come asking me. The result is that you've got ten kids around you all the time and you see nothing of what's going on in the classroom.*

Experiences such as these influenced teachers at Cross High School to abandon the use of ASEP materials. There was a lack of appreciation of the ideas underlying the Project development, in addition to a lack of planning for the use of the materials in the classroom.

Factors Affecting Implementation *Cross High School had found difficulty during the period from 1970 to 1976 in attracting and retaining suitably qualified graduates to teach the sciences. When such staff were recruited, there was a tendency to employ them to teach biology at Years 11 and 12. In the junior school science program there had been a procession of teachers over the years, to the extent that the librarian described the science department as 'a place where young men could come for a year and teach in between completing their qualifications'. The problems of teaching science were exacerbated because the school had not developed a curriculum for the subject since the external public examination syllabus had been made obsolete. In 1973, the school administration initiated a review of the organisation of the science department with a view to improving the quality of the programs offered. In 1974, the school appointed an experienced and highly qualified teacher to the position of Head of Science (H/S). One of her first tasks was to plan a science curriculum, and to upgrade the curriculum resources of the department.*

Up to this time, all science students purchased a conventional textbook. Somewhat by accident, the H/S found that many students had difficulty in reading passages from this text. Rather than the school purchase further textbooks with this deficiency and so perpetuate the problem, the H/S sought alternative materials. A book hire system was introduced. This involved the payment of a levy by students for science, and the purchase of class sets of textbooks and curriculum materials. Although the H/S had not taught in the State for some time, she was able to make contacts with experts in curriculum development in the State Education Department. By attending curriculum workshops, and contacting consultants, information was obtained about ASEP materials. In 1974 the school ordered a range of ASEP units and by the end of that year had purchased a complete set of inspection packs. There were also sufficient module packs in the school to allow 13 separate units of work to be fully attempted. No delivery delays were experienced; by December 1974 materials were available for use in science for the following year.

However, the implementation of ASEP ran into some major difficulties in 1975. The H/S was also expected to carry out major administrative duties. The amount of time that she could devote to the science department was considerably reduced compared with 1974.

In addition, there was a further turnover of staff teaching science. Four of the six science teachers in 1975 were new to the school, and this was their first teaching position. The chances that these teachers were familiar with the objectives of modern science curriculum materials such as ASEP were reduced because three had not taken any form of pre-service education. ASEP materials had been introduced into a school where no detailed planning of a syllabus had taken place. In addition the H/S had not used the materials and was unable to devote sufficient time to considering how best to deploy the materials with the inexperienced staff available.

The successful introduction of even small amounts of ASEP materials requires efficient storage and accessibility to textual materials and apparatus. Problems arose at Cross High School because of the attitude of the laboratory assistant. Due partly to inadequate direction from the H/S the assistant had not arranged units so that teachers had easy access to them. Moreover personality clashes occurred between some of the young teachers and the assistant. He attempted to impart his knowledge of more traditional science teaching to teachers, which was often not asked for and often irrelevant to the present situation. During interview he observed that:

> *..... lots of the teachers haven't had the experience I've had, and if I get the chance I tell them things, but they just don't want to know.*

Throughout term I, 1975 teachers were forced to organise their own apparatus and materials. This was an additional imposition which militated against successful use of the ASEP units. An effort was made to improve the situation. During the first term vacation in 1975, teachers spent time storing and labelling the ASEP units in such a way as to make them easier to use in the future. The consultant visited the school and helped the teachers of science plan a curriculum for the remainder of the year. A report from the H/S described the situation in the school for the rest of 1975:

> *Despite the coordinator's attempts to explain that ASEP materials did not, as such, constitute an entire course, and back up in this view (sic) by a science consultant, most teachers insisted on using these materials almost exclusively during the first two terms. With this experience though, teachers used other materials in the third term and, in some cases, a more teacher centred approach in some topics, as well as using the ASEP materials, or even the teachers' book on its own as a basis for a topic. I feel that this experience has now put the teachers in a better position to see how to use and integrate various curriculum materials and approaches to teaching the children.*

In 1976, changes to the staffing structure further contributed to the lack of organisation and planning in the department. The H/S withdrew from the science department. A member of staff who taught only senior school biology assumed the position of H/S. The new coordinator, well meaning and keen, had only recently entered the

> *teaching profession and had only taught biology. Her limited background as a teacher was a problem in that she had little knowledge of recent developments in science education. In addition, she lacked credibility as a leader amongst the rest of the science staff. Her reluctance to teach science was a further factor which contributed to a feeling that the new H/S could not appreciate the problems they faced in teaching science in the junior school.*
>
> *The curriculum which evolved in 1976 and 1977 reflected a traditional approach to science teaching. The program was mainly the work of the H/S. There were few meetings of the staff as a group and communication between teachers in day to day duties was minimal. A curriculum statement which appeared in draft form in 1976, setting out the units to be taught, appeared to be ignored by most of the science staff. The result was that teachers decided, on an ad hoc basis, the topics they would teach. In this climate, teachers tended to select 'bits and pieces' from the ASEP materials, and in many cases the essential character of teaching based on ASEP ideas was not preserved.*
>
> *Curriculum statements for science at Cross High School were divided into compartments based on the traditional disciplines. Thus the subject was not organised in a way in which the ASEP units could be a major resource. Each science class was taught a term of physics, a term of chemistry and a term of biology. In the Year Eight program, the 'physics' topics included: Archimedies Principle, levers, mechanical advantage and an historical study of the influence of Galvani and Volta. In the Year Ten program, time was devoted to a detailed study of the properties of carbon, and its forms, the learning of organic compound formulae and the derivation of hydrocarbons. There had been a reversion to an emphasis on content. There was also evidence that the amount of activity work carried out by students had declined. Teachers who had the choice of conventional classrooms or laboratories for their science classes preferred the classrooms. A new laboratory assistant reported that ASEP units were rarely used. Noting that she was not fully occupied in the science department, the school administration found tasks for her in the general office of the school.*

The experiences of the teachers at Cross High School illustrate the importance of contextual factors in determining the fate of an innovation in teaching. Lack of knowledge of the innovation or the lack of ability to plan for the use of the materials on a small or large scale made the chances of successful implementation of the materials in the classroom slight. A high climate for innovation would be needed at Cross High School for effective use of the ASEP materials to occur. In this school, the teachers developed negative reactions to the ASEP materials due to local factors, some of which were beyond their immediate control. ASEP will, in the near future, be no more than a peripheral resource material in the science program, as teachers move to more traditional didactic methods of teaching. Note that a second order of ASEP materials, tentatively planned for 1976, was cancelled.

An Innovative Low User : Various Methods and Materials

At Major High School, ASEP materials had been adopted in order to serve the needs of a segment of a total science curriculum. The incorporation of ASEP had been carefully considered by the staff involved in teaching science before the materials were introduced into classrooms.

> *Major High School was a suburban school with a student population of 1,000. There had been relative stability amongst senior staff, from principal to subject coordinator levels over the four years from 1974, and this had formed the basis for the development of a total school curriculum. By 1976 a handbook had been produced to inform parents and students about the courses offered. This document showed that the school was divided, for the purposes of curriculum organisation, into junior and senior sections. Science was offered as an integrated subject in the junior curriculum, and all students studied the subject.*
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> *In the senior curriculum, physics, chemistry and biology were taught as separate subjects, and in addition a course in Integrated Science had been introduced at Year 11 in 1976. This course was topic centred, and was based on 'relevant' issues, for example 'the energy crisis' and 'drug addiction'. This was a terminal course designed for those students who had an interest in science but were not inclined to study the more academically orientated subjects.*
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> *Indicators of Implementation* In the science curriculum in the junior school, ASEP units were employed at all year levels, but the extent varied with year level. The major use of the ASEP materials occurred in Year Nine where about one-third of all class time for science was based on ASEP units. In Years Eight and Ten, the first and last years of the junior school, the extent of use was less, one unit being used in Year Eight, and three units being used at Year Ten. A large number of curriculum resources were utilised*

in conjunction with the ASEP units. Project materials such as the Junior Secondary Science Project (JSSP) and the Intermediate Science Curriculum Study (ISCS) had been adopted in amounts comparable to the ASEP materials. In addition, a conventional textbook was owned by all students, and it provided a resource for teachers and students in periods when the curriculum project materials were not employed.

All science classes at Major High School were taught in laboratories. An indication of the importance of science was that some senior physics classes, which would have had first call on laboratory space in many schools, were moved into conventional classrooms to allow science classes to use the better facilities. The availability of these facilities, combined with the effective support of two laboratory assistants provided a set of conditions which were conducive to the implementation of ASEP materials.

The science program was based on a topic approach. A flow chart showed that selection of topics at each year level depended on their links with topics at other year levels. The links indicated the distinct 'subject area' basis for the selection of topics. The underlying importance of subject areas was particularly evident in the topics chosen at Year Ten. Teachers stated that a major concern in teaching at this level was to prepare students who would continue with chemistry, physics and biology in Years 11 and 12. This was a surprising response, for very few students actually continued to Year 12 studies in science. Of the 280 science students in Year Ten, less than 10 studied chemistry or physics or biology at Year 12.

The science teachers at Major High School planned carefully for the incorporation of ASEP materials into the curriculum. For those units which had been selected, the appropriate teachers' guides, student texts and record books had been purchased. Sufficient student texts had been ordered to enable students to work in groups of two or three. This enabled classroom activities to proceed without the problems associated with too many students working together on a learning sequence at the one time.

At Major High School, the laboratory assistants were important members of the science department. They found that the use of ASEP required the assembly of large amounts of apparatus before classes began a unit. Laboratory assistants and teachers were unanimous that the lists of apparatus required found in the teachers' guides of each unit were of great value in the preparation of the units.

Teachers reported that some ASEP characteristics were adopted while others were not. For example, not all of the options for each unit were made available to the students. Before a unit was implemented, the two Heads of Science (H/S) in conjunction with the teachers involved made decisions about the number of options which would be offered. The major reason for deleting an option was unavailability of apparatus. Also, because ASEP units were used within a broader program, time was a factor in curtailing the range of options which were made available. The conduct of ASEP classes *was heavily dependent on the extent of planning which took place before the unit was taught. The knowledge and experience of one of the H/S in particular was a significant factor in planning for the use of ASEP units at the school. This H/S, through involvement in ASEP trials, had a comprehensive knowledge of the ASEP materials, and he was a major influence in the selection of appropriate units for the science program.*

It was the policy of the science department at Major High School for students to be given a choice of the options available in ASEP classes after all had attempted the core. This procedure made it difficult to use the ASEP data on reading and intellectual levels for each option which was included in the teachers' guides. In general, science teachers were of the opinion that an advantage of ASEP materials over most other forms of instruction was that ***students*** *could make choices about what they studied. The allocation of students to specific options on the basis of their intellectual or reading levels would have been at variance with the concept of student choice. Nevertheless, some teachers used measures of reading ability of students, which had been collected by the school, to match options to students of low reading ability. It was found that this enabled classes to proceed with less disruption than when this matching had not taken place.*

The observation of particular classes during the school visits was illuminating in that it highlighted a number of factors which influenced the conduct of teaching when ASEP ideas and materials were used.

One Year Eight class was working on the unit 'Graphing, Averaging and Reading a Scale'. The unit was part of a carefully constructed sequence of teaching designed to introduce first year students to skills required in the laboratory. It gave students their first chance to work alone, and had been chosen deliberately for that purpose. The students observed were at different points along the sequence. The teacher sat at the front of the room and answered a stream of student enquiries. The students came for assistance on their own initiative and were free to consult other students if they wished. Most worked steadily and there was little need for the teacher to ask students to get on with their work. As students completed one of the subsections, the teacher checked that the answers to the calculations were correct. Throughout the class, there were few periods when she was not helping a student. The unit was of interest to the students and the teacher felt it worthwhile as an introduction to basic skills.

In the second class, Year Nine students were working on the ASEP unit 'Digging Up Evidence'. The laboratory was well set up for the experiment. Students were able to get to work quickly after selecting their materials from the boxes laid out by the laboratory assistant. Most students examined moulds they had made as part of the core activity of the unit. The students showed great interest in freeing the plaster from its mould. The casts were, in general, excellent reproductions of the samples. Most of the students were pleased with the results. For the remainder of the 40-minute period, the teacher was occupied in assisting the slow learners with questions related to the core activity. Students who were further advanced were attempting a test or working on options. However, the test was not being seriously attempted by about a third of the students working on it. No one completed the 18-item test in the period, although there appeared to be ample time for them to do so. A hitch arose with those students who had advanced to the options. At the commencement of the class, the teacher listed the numbers of the options which were offered on the blackboard. It was not made clear that students had a choice, and consequently most commenced the same option, the one corresponding to the first on the list. Only at the conclusion of the period did the teacher realise that his instructions had been misconstrued. This teacher worked hard throughout the lesson, and seemed keen to use the ASEP materials. However, it was clear that some students did not work to their utmost for the entire 40 minutes.

Another Year Nine class was observed during a lesson. The teacher gave virtually no directions. The students worked on a range of options, apparently without great difficulty. The class had become accustomed to working with the ASEP units through their use in 1975 and 1976. The teacher was very positive about the working atmosphere in his classes.

> I don't even have to be in the room now, when they do the work. Possibly the best thing about them (the ASEP units) is that it gives kids something to do, within their scope, and the units seem to be written at a level that most of them understand.

Two conclusions which could be made from teachers at Major High School are illustrated by the examples above. First, the problem of control varied from unit to unit. The teacher using the unit 'Graphing, Averaging and Reading a Scale' had a relatively easy organisational situation, because the students were not using apparatus, and the class as a whole were working on approximately the same exercises. By contrast, the teacher working on 'Digging Up Evidence' was constantly faced with the problem of 'turning off' in one phase of the work to concentrate on the other. The emphasis on supporting the slower learners meant that those more advanced were left to regulate the rate of their own progress. Secondly, science teachers felt that students needed to have some experience with ASEP in order to adjust to the use of the ASEP approach. Most teachers reported that it was not until students had worked through two ASEP units that they became accustomed to knowing what to do, being able to translate written instructions into action, and proceeding from one activity to the next. Experience over time prompted the H/S to recommend that ASEP units be taught with some teacher direction, while still retaining student enquiry as the basic form of learning. One of the major problems in using the materials with large classes, thirty or over, was the degree to which teachers could continually monitor the activities of all students, whilst at the same time giving attention to the specific problems of one or two students. The difficulty *became major when a unit involved students working with dangerous chemicals. In these cases, a class demonstration or more closely controlled 'lock-step' activity was preferred.*

Factors Affecting Implementation At Major High School, ASEP materials were one resource set of materials which were incorporated into the science program. When these materials were used, it was evident that they had been carefully selected and implemented in a manner which was sympathetic to the intentions of the ASEP developers. The ideas of the ASEP endeavour had influenced more of the program than just those sections where ASEP was used. This was shown by the subsequent inclusion of ISCS and JSSP materials at most year levels. ISCS was similar in form to ASEP. Choice of ISCS over ASEP was based on the content of the units available. For example, at Year 11 there were ISCS units suitable for the Integrated Science course, whereas suitable ASEP materials were unavailable.

Two major factors militated against exclusive use of ASEP materials in the program. First, there was a reaction by teachers against the exclusive use of teaching methods based on individual progression methods. This was due to historical factors. In the early 1970's, most of the science teaching had been based on programmed learning courses produced within the school. Science classes during this period were conducted such that students rarely experienced any other form of teaching. There was also concern about the quality of some of the learning sequences, and with students who became bored because of the similarity of teaching strategies throughout the program. When the present H/S's were appointed in 1974, they were dissatisfied with these learning strategies and there was a move to introduce a variety of teaching methods. At the same time, it was recognised that activity based learning had a place in the program if better quality sequences could be found. The ASEP materials were chosen as the basis for this method of teaching.

The second factor was that students owned a textbook. This was in accordance with school policy. The science textbook emphasised knowledge of scientific facts and principles, and was viewed by teachers as being of value as a source of homework assignments for the students. Teachers were of the opinion that students should learn many of the facts and principles covered by the text. Accordingly, a proportion of the total science program was based on teaching of a more didactic fashion than with the ASEP units.

The most impressive aspect of the science program at Major High School was the involvement of the teachers in the ongoing development of the curriculum in the interval between 1974 and 1977. This was a period in which there had been little turnover of staff in the department, and in particular, no change in leadership. The H/S's set a standard of professional concern with the quality of the courses offered in science. The remainder of the staff responded by becoming involved in planning sessions which were often held after school and in evening working groups.

> *A first draft syllabus for each year level was used as the basis for the science program in 1975. The incorporation of appropriate resource materials for the topics selected required teachers to have up to date knowledge of the latest texts and curriculum materials. The H/S's encouraged staff to attend inservice courses and to visit resource centres where possible. Curriculum consultants were also of assistance. They were welcomed into the school to assist in planning and to display the range of texts and curriculum project units which could be useful.*
>
> *By 1977, the program had been consolidated in that teachers believed that few changes should be made in the next few years. There had been little change in the extent of use of ASEP materials, just some minor rearrangements to the allocation of units to different year levels. However, the teachers were not content to rest on their achievements. A concerted program of evaluation, initiated by a relatively junior staff member, had been commenced. Teachers were interested in whether the curriculum they offered influenced students' attitudes to science.*

At Major High School, a strong Innovation Climate existed in the science department and was a major factor in the successful development of a comprehensive science curriculum. Teachers were professionally orientated in that they were eager to try new curriculum materials. Within the science department a cohesive approach to curriculum planning was evident. The H/S's provided strong leadership; their experience and dedication were acknowledged by other staff members. Within the science department, science was perceived as being of equal importance to senior level subjects such as physics or biology. All teachers of science were involved in the junior as well as in the senior school. In these circumstances, it is not surprising that the ASEP materials had been implemented, in most respects, in accordance with the suggestions of the ASEP developers. Where variations occurred between practice and criteria, they appeared to be justified.

An Above Average Innovative User : Acceptance of New Norms for the Science Program

Only a small proportion of schools in each State was classified as

Above Average Innovative Users, and Kree High School was an example of the schools in this group.

Kree High School was a large inner city high school with an enrolment of 1,400 students. Science was studied in Years Eight to Ten, and in addition there were traditional science subjects offered at the two senior levels. The size of the school meant that there were many science classes, 12 at Year Eight, and nine at each of the other two levels. Fourteen teachers were involved in teaching science; this posed a major organisational problem for the Head of Science (H/S) in coordinating the subject.

Indicators of Implementation *Units of ASEP had been adopted in relatively large amounts (compared with other schools in the State) in 1974 and 1975, and further small purchases followed in 1976. The ASEP materials were the means by which the rationale of a curriculum statement for science which had been written by the H/S was transferred into action in the classrooms. This statement was notable because it considered the total curriculum for science, rather than being just a list of topics. The statement included a set of aims or intentions which were classified as cognitive, manipulative or affective. Guidelines were also included for the achievement of these intentions. These related to the conduct of the classes, the choice of teaching units, and the way homework might be set. Throughout, there was an emphasis on the processes of science rather than on the learning of content. The deemphasis on content was detectable throughout the statement. For example, on homework:*

> *The traditional concept of homework is no longer applicable in many instances. Homework will probably fit into one or more of the following categories:*
>
> *(i) Writing up summaries of work performed,*
> *(ii) learning of summaries,*
> *(iii) planning experiments and collecting equipment which is not available from the school,*
> *(iv) library research,*
> *(v) extra practical activities at home.*

These directions represented a departure from long standing practices which involved the use of traditional textbooks.

The importance of student appreciation of scientific methods, outlined in the statement on homework, was also reflected in the way science classes were organised in the school. Student enquiry was central to the teaching methods and, as such, required very efficient use of the available laboratories. This was achieved because the H/S had a very strong influence in determining the structure of the school timetable and resulted in science classes having first priority on the laboratories. Previously this had *not always been the case. The efficient use of rooms was achieved despite the lack of facilities in some of the laboratories in the school. These were grouped in pairs in four distinct locations in the school grounds. In each pair, one room was adequately equipped with utilities; there were water, gas and electricity outlets at appropriate positions around the room. The other room of the two had been constructed as a teacher demonstration laboratory, and there were limited utilities available. The H/S had overcome the problems of poor facilities in the following ways. All science classes were arranged in four-week blocks. All students at a given year level were taught at the one location, that is, in one of the groups of laboratory/demonstration room combinations. At the end of a four-week block, students in one class moved from the laboratory to the demonstration room and their place was taken by a parallel class which had just worked in the demonstration room. All classes worked on activity-based courses, particularly ASEP units. This was possible in the demonstration rooms because ASEP units used there were those which required a minimum of facilities found in conventional student laboratories.*

The use of ASEP units necessitated a detailed examination of the characteristics of each unit before the materials were used in classes. The H/S had set up a storeroom as a repository for the large amount of written materials. These were clearly labelled and indexed by the laboratory assistants when the materials were delivered to the school. The science teachers were encouraged to spend their free time examining units which they would be using in the future. The H/S made final decisions about which sections of the units were to be taught. There were constraints on choices between options in each unit because of the length of time (four weeks) available for student study of each unit, and other factors such as the unavailability of apparatus. In general, the core of the units were retained as suggested by the ASEP developers. In some cases, it was also decided to make a particular option in a unit compulsory where this option covered material thought to be particularly relevant to the course.

The teachers' guides were considered by the science staff to be useful in the setting up and conduct of units. In particular, information related to the apparatus requirements of core and options was of great benefit to the laboratory assistants in preparing trays of materials for use by students. ASEP student texts were used in all ASEP classes, and through a system of policing of textual materials agreed to by the staff and laboratory assistants, there were almost no losses of these texts over the period in which the school was under review. Initially student record books were used throughout ASEP classes in the school. However, over time, teachers found that students became less careful with the way written material was entered into these books. By 1976, most teachers insisted that students use conventional exercise books, except in cases where record books included essential diagrams or tables.

There were a number of features of the ASEP development which were not incorporated in the implementation of ASEP materials in the science program of the school. No use was made of information which described the intellectual levels of the ASEP options within units. One of the factors which affected this was that no data were available in the school by which the stage of intellectual development of each student could be assessed. A second factor was that when students undertook options many teachers preferred to group students according to their preferences to study a given topic rather than to allot them to the topic. When students worked on an option that interested them, teachers found it easier to manage the ASEP classes.

No use was made of information in the teachers' guide which related to the reading levels of options. A factor which affected this was that the school did not carry out a program of measuring the reading levels of the students. Even if this information had been available it was probable that the grouping of students to carry out options would have been made on other grounds. Most teachers found that options work could proceed smoothly by grouping a proficient reader with others of lower ability. The proficient reader acted as a leader in the conduct of the option, particularly in the translation of written instructions into activity.

Also, student tests were rarely employed in the manner in which they were intended. There was a general attitude amongst the science staff that assessment of students should be made at the end of each unit. This was consistent with the school's requirement that all students be given a grading at each year level. Tests of a general nature which measured underlying concepts and processes common to the study of science were used to grade the students. These tests were used as within school moderation instruments. Classes studying different ASEP units at the same year level were thus not disadvantaged. The use of a 'content free' test was important in that it enabled a high degree of flexibility in the matching of units to classes, and also allowed different sequences of units with different classes.

As a result of teaching ASEP units in 1975, changes were made in the allocation of units to particular year levels in 1976. For example the unit 'Forces' was found to be too difficult for the majority of students at Year Eight. Consequently it was moved into the Year Nine course. At this level, there were some differences in the general ability of class groups. ASEP units were selected to suit different class groups on the basis of previous use. For example, the more able class groups studied 'Microbes', a Stage Two unit, while the other class groups studied 'Pigments and Acidity', a Stage One unit. Although intellectual level information within units was of limited use to teachers, it appeared that intellectual level information about each unit as a whole was useful as a basis for matching learning activities to class groups. However, it was important to note that the allocation of units to classes was also made after using the materials in classrooms.

Factors Affecting Implementation The implementation of a science program based heavily on the use of ASEP followed a period in which the curriculum in the school had been of a more traditional format. The stimulus for the decision to change the curriculum so radically was traced to the participation of the H/S in the formative trials of the ASEP materials during the period of their development.

The H/S was successful in achieving the change despite circumstances which may have acted as a deterrent to a less determined coordinator. The H/S overcame certain objections put forward by the school principal. His major concern was that students would no longer own a textbook, and that parents would object to a levy system which needed to be imposed to finance the purchase of the ASEP materials. The relative seniority of the H/S, and his high reputation as a coordinator in the school in which he had taught for seven years, were factors which were instrumental in overcoming the principal's alarm over the switch to the new scheme.

From 1975, the science program was based on activity centred classes using ASEP materials. Little or no parent objection to the change to the levy system was encountered. The demand by students to work on science projects outside school time forced the school to introduce copies of ASEP units into the library.

There was a general consensus of approval of the staff who taught science regarding the administration of the science program. A spirit of cohesion existed amongst the staff, brought about by working within an acceptable framework of administration and organisation which had been established by the H/S. The cohesion was necessary for the maintenance of the program, because the use of ASEP units in such large amounts required that the H/S, the teachers within his department, and the two laboratory assistants were continually engaged in checking textual materials and apparatus.

New teachers coming into the school were also affected by a spirit of professional pride in the conduct of a science program which was considered to be unique by teachers of science in neighbouring schools. The influence of the H/S, his involvement in committees and the science teachers' association appeared to influence other teachers to become involved in similar commitments outside the school.

The reaction of teachers to the program was typified by the responses of teachers within the school with vastly different educational backgrounds. An older teacher said:

> As far as I'm aware everyone (on the science staff) seems happy to go along with ASEP. As for me I've been used to getting up and telling them (the students). In the past, if you had the apparatus, you demonstrated. If you had insufficient lab space, you didn't try and demonstrate. Now with the ASEP the kids have their hands on the apparatus all the time. I find the change a bit strange, because what I'd normally do in a day takes a week under the new set-up. Sometimes with the ASEP it's

> *a bit hard to pin down what they are supposed to have learnt in a particular option. A kid has still got to know his facts; they are still important, so as well as the record books, the kids have to prepare a summary at the end of the option.*

Compare this reaction to that of a beginning teacher:

> *My teacher training lectures in science were all for ASEP, they were all the time showing ASEP to us, showing us films, etc. When I came here that made it easier. When I started teaching ASEP they (the students) weren't following the instructions step by step. So I went through each activity with them. Even now I have some difficulties with students not bothering to read, and skipping down to the first 'writing sign'. However, when I sit the kids down and give them a straight lesson, to me it seems strange to stand up in front of them. You think the kids are going to be really bored with just me talking. I think the majority of kids in my classes seem to be happy doing activity work. I wouldn't want to go back to the old system because I feel it would be too dreary. The main problem is getting from group to group. An ASEP lesson is a very busy lesson for the teacher if they are going to supervise each group properly and I find this a bit difficult sometimes. Also, it's a bit difficult to keep my eye on a group up the back, when I'm involved in a discussion with a group up the front.*

These reactions suggested that different individuals made different adjustments to their teaching styles. In both cases there was a critical acceptance of the use of ASEP materials in the school.

At this school most of the aspects of ASEP had been incorporated and they formed the basis of the total science program. A number of factors contributed to the extent of implementation. First, the H/S had been directly linked to the ASEP development in the trials stage and he had been impressed with the characteristics of ASEP as a framework for teaching science. Secondly, he was able to persuade other science staff to adopt the materials. He was the link for the teachers involved and communicated the objectives of ASEP through discussion and reference to important documents such as 'A Guide to ASEP'. Thirdly, the status of the H/S in the school was such to overcome the potential barriers to curriculum change which arose at the school level. He had a role in the planning of the timetable and so was able to guarantee the most efficient use of the facilities available. At Kree High School laboratories and other ancillary rooms were used with utmost efficiency. In fact, facilities judged by teachers in other schools to be unsuitable for science were turned into useful work areas at this school. The effective use of the laboratory was associated with the extremely detailed knowledge the H/S had of the characteristics of all ASEP units. This resulted in the allocation of suitable materials to rooms with different standards of facilities.

The administration of the science program relied on a two-stage decision making process. In the first, the H/S provided suggestions for the organisation of the total program and for its conduct. In the second, all other teachers involved met to discuss, and on most occasions, to ratify the H/S's decisions; an approach generally accepted by the science staff. Major tasks, such as ordering equipment and textual materials, and writing of curriculum statements, were carried out by the H/S. Minor tasks, such as writing content summaries of individual units, were carried out by other teachers. This division of responsibility facilitated implementation. It enabled the teachers of science, most of whom were inexperienced, most of whom were teaching in other subject areas in addition to science, to concentrate on organising their science teaching activities.

It is clear that the science program at Kree High School depended greatly on the skills of the leader. When in late 1975 he was required, for a time, to assume another senior administrative position in the school, his replacement did not provide teachers with the same level of support. Laboratory assistants were particularly affected as apparatus and materials were not checked as regularly as previously. Student textbooks were misplaced or stolen and teachers of science began to bypass the acting coordinator to seek assistance from the H/S. In 1976 and 1977, when the H/S returned to his post as coordinator of science, the program returned to its former stability.

Conditions Associated with Implementation

From information collected in the 13 schools some generalisations can be made about the factors affecting curriculum change involving the use of ASEP materials.

Where a high Innovation Climate existed the following characteristics were also observed:

(1) Science was perceived by members of the science department to be at least as important a subject as other science subjects taught in the senior school. This attitude was manifested by factors such as the preferential allocation of the better laboratory facilities to science classes and by the preference of most staff to teach science when given the choice by the Head of Science.

(2) A curriculum plan for science had been formulated and written down in such a way that it contained not only a statement of content but also some indication of the aims of the courses, the methods and materials which would be employed and means by which students' performance would be evaluated.

(3) The curriculum had resulted from the cooperative efforts of all members of staff teaching science, and had been developed and modified over a period of years. In most cases the interval between 1973 and 1976 was the period when its formulation had taken place.

(4) The major impetus for the formulation of a science curriculum plan had been by the Head or Heads of Science. The planning and implementation of the curriculum had taken place while there had been continuity of leadership in the period between 1973 and 1976.

When ASEP materials were used in schools with a high Innovation Climate:

(5) The Head of Science had often been a member of an ASEP trials team and used the materials during the formative stages of the ASEP development. His experience had been of major importance in the decision to adopt ASEP ideas and materials into the science curriculum.

(6) Implementation of the materials generally took place in accordance with suggestions made by the ASEP development team. (A discussion of the extent of implementation is included below.)

(7) High rather than low use was generally associated with extreme dissatisfaction by the science staff with the science program which had been taught in the years immediately before ASEP units were made available. In the schools where high use occurred, the ASEP philosophy pervaded the entire program, and the materials became

the basis of the science curriculum. In the low use schools, ASEP had been introduced as a complement to other textual materials, some of which were more suitable to teacher centred methods of instruction.

Implementation : Potential and Practice

From the school visits generalisations can be made about the extent of congruence between the ways in which ASEP materials were implemented in practice and the criteria which assembled from an analysis of the guidelines set out in 'A Guide to ASEP'. In this discussion, conclusions are drawn from an analysis of implementation in those schools where there was a high Innovation Climate. In these schools deviations from suggested use seemed to be justified since decisions about adaptation were made by teachers who had used the ASEP materials and after due consideration had been given to the introduction of them into the science curriculum.

Most teachers in these schools spoke favourably about the ASEP Inspection and Module packs. However, there was a widespread negative reaction to the Record Books of many units. The chief concern of teachers was the quality of the notes which students wrote in the books and their suitability for future reference. Many teachers insisted on students using an additional exercise book for note taking or rejected the record books completely in an attempt to improve the general quality of written work of their students.

Of all the innovatory concepts of the ASEP development, student centred learning was the most noteworthy observed. Teachers appeared to have greater success with the option system when students had been carefully introduced to it. The system created difficulties however, in classes of greater than 30 or where the laboratory facilities or equipment were such that students had to work in groups of five or more. In two schools where the period length was less than 40 minutes teachers found it difficult to consult all groups of students during this time interval.

Laboratory assistance is now provided in most schools in Australia and consequently student activity in science is more likely than was once the case. ASEP teachers' guides contained lists of apparatus requirements. This was appreciated by teachers and provided laboratory assistants with directions for assembling the equipment required. Where ASEP was used throughout the entire science program it was necessary for assistants to work collaboratively with teachers in materials preparation. In schools such as Kree High School, staff and laboratory assistants were consistently checking apparatus, chemicals and student texts.

Science teachers made little use of information which described the intellectual levels of the ASEP options. One reason for this was that many teachers allowed students to select options rather than assigning them. Ability to choose was seen by teachers as a major benefit of the ASEP approach. Another reason was the lack of suitable measurement instruments to assess the intellectual development of students.

Very little use was made by science teachers of the data relating to the reading levels of ASEP options because teachers lacked the appropriate data about their students. A few schools, such as Major High, tested all pupils for reading ages when they entered the school, but this practice was not observed in most of the other high innovative schools visited.

The question of suitable assessment consistenly recurred in discussions in schools. The two most common facets were: first, the necessity to provide information by which students at one level could be ranked in the school, and second, the determination of whether or not students had achieved the aims stated for the core and options of a particular unit. ASEP materials included only diagnostic tests for students to administer to themselves at appropriate points of the unit.

Variations in the order of use of ASEP units in the schools and the use of different units for different class groups at a given year level made meaningful comparisons between the schools difficult. At Kree High School, the problem was largely solved by using a general test of skills and knowledge which students could be expected to attain through studying science. Whereas this form of moderation within schools has merit, it requires much work from teachers and a grounding in test theory and test construction.

Most teachers of science felt that the performance of students should be assessed with the help of an end-of-unit test. For example, Major High School used a common test of the core materials written by one of the teachers. Testing in most schools concentrated on knowledge of factual information. Very few attempted to create forms of assessment which encompassed affective as well as cognitive outcomes.

Concluding Comments

This chapter, which described schools representative of the typologies established in chapter Nine, is regarded as an essential one for the complete documentation of the fate of the ASEP innovation. Amalgamating schools (and teachers) into typologies, though useful, could not be employed directly as a method for assessing the extent of implementation of the ASEP characteristics. The case studies were designed to achieve this end and they showed variations between schools in the degree of departure from ASEP guidelines.

The congruence between the case study descriptions and the categorisations of the typologies, established in chapter Nine, were extremely encouraging and imply that the method for selecting schools for intensive study was most successful. So much so, that it seems reasonable to postulate a strong associative link between relative successes in implementing ASEP and the Innovation Climate in a school.

Finally, an observation regarding measures of implementation. Questionnaires can provide information on the amount of time spent on ASEP and the number of units used in schools, but few details on the way the materials were organised for use and implemented. As the discussion in this chapter shows, to document fully and accurately the nature and extent of implementation requires the use of many techniques including questionnaire, interview, observation, and inspection of documents.

CHAPTER ELEVEN

IN RETROSPECT

Introduction

The purposes of this final chapter are to review the salient features of the study, synthesise the detailed findings reported in previous chapters, and comment on the successes and shortcomings of the research endeavour. The study has taken place over a period of four years, and about half of this period has been devoted to the collection and analysis of data. This has involved considerable emotional energy, commitment and personal effort and, consequently, it is extremely difficult for the author to be completely objective when evaluating the worth of the study. Nevertheless, such an evaluative task will be attempted.

The ASEP curriculum endeavour was launched at a time of flux in Australian education. Most States had previously introduced curricula into schools along the lines of the Research, Development and Diffusion model (R, D and D) of educational change. Now ASEP, a centrally produced curriculum, appeared as education systems in most Australian States were promoting greater autonomy for schools in all stages of the curriculum process. Thus the factors associated with ASEP's acceptance or rejection could not be clearly equated with those discovered in other studies of innovation in education, most of which had been carried out overseas, no matter how plausible they may have appeared for Australian conditions. That schools were now playing the major role in all aspects of curriculum development added further complexities to aspects of dissemination of change which have traditionally been studied from the R, D and D perspective.

It was recognised that detailed information had to be collected about the schools and characteristics of the educational milieu - or to use the phraseology of the study, the educational medium - in order to tease apart those factors which influenced the effect of ASEP on secondary school science programs.

The importance of school level factors made it apparent that the theoretical formulations underlying the R, D and D model of change would not be applicable as a framework on which to base the study, or to guide data collection. Rather, a framework was constructed which acknowledged the key roles of the users, and the importance of support systems based outside the schools. Further comments on this framework are presented later in this chapter.

The framework was shaped in conjunction with the formulation of basic research questions which were used to guide data collection. One question was associated with the extent to which ASEP materials had been adopted and were actually being used in schools. Another question was concerned with the roles of educational mediums in fostering and facilitating the adoption and implementation of ASEP and their modes of presenting ideas in science. A third question was concerned with the details by which ASEP influenced the teaching programs in science departments. Data associated with this last question was collected through extensive case studies reported in chapter Ten.

In retrospect, the basic research questions appeared to be appropriate for the study of adoption and implementation of a significant innovation in curriculum in Australia. They led to a number of subsidiary questions regarding methods of data collection, analysis and reporting. The target population for ASEP's products was secondary schools, and it was this population from which the sample used in this study was drawn. Consequently, the results and implications are of direct concern to those in secondary schools. This may be seen as a limitation of this study in that there may be few implications for primary (or elementary) school educators. What is needed now is a study of similar ilk to this research but directed at the examination of the impact of centrally produced curriculum in Australia designed for primary schools.

Some Salient Features of the Study

Several features of this study set it apart from many other research efforts related to educational innovation and change. First, few of the studies reviewed in earlier chapters base some or all of their data collection on constructs based on theory. By contrast, this research, albeit cautiously, was founded on certain conceptualisations which were originally derived from the work of Ronald G. Havelock. At the time this study was launched, his general framework for conceptualising change provided a valuable basis for the paradigms used here. Subsequently, the results of other research, which related particularly to educational change, enabled tentative associations of cause and effect to be formulated. In particular, this resulted in an identification of key change strategies of educational mediums and in the characterisation of the Innovation Climate on which schools would differ. Scales measuring the Innovation Climate, coupled with information relating to the use of ASEP in schools, yielded useful results which were readily interpretable and helped in accounting for variations in the implementation of ASEP's ideas into science curricula. The scales were not a panacea but, combined with the other measures outlined above, provided a useful dimension by which to categorise science departments.

A second special feature of this study is the use made of a variety of data gathering and analytical techniques. Simple statistics, for example averages and percentages, are used along with more sophisticated procedures like cluster and multiple discriminant analysis. In addition, non-quantitative methods were employed where they were deemed appropriate. Whereas any one of these procedures may appear, at first glance, to be insubstantial, together they yield a comprehensive picture and give the study an added robustness not found in some other examinations of curriculum innovation and change.

A third unique feature is that this research dealt with a representative sample of schools throughout the country. The study was thus a national one but, at the same time, it employed a progressive focussing on State education systems and schools. Certain State systems were studied and compared with each other. Schools of particular interest were considered in detail. The author is unaware of any other study which incorporates the examination of the adoption, reported use and implementation of a centrally produced curriculum innovation throughout a whole nation.

A fourth salient feature is that the basic unit, or entity, for the analysis of user effects, was a group, the science department within the school. By contrast, most other research studies of curriculum innovation have focussed on either the teacher or the school, rather than that group of persons constituting a department or teaching unit within the school. The choice of the science department as the entity in this study was deliberate and was based on a considerable amount of evidence which suggested that these departments decided about the nature of the schools' science programs and, consequently, were the most potent factor influencing the adoption and implementation of new curricula.

A final, but by no means least important feature of this study, is that it directed attention to several facets of curriculum innovation. Few other research efforts in this area direct attention to more than one facet of dissemination, adoption or implementation. Coupled with this feature, there was an added strength; findings were reported at three levels, namely: school, State and national. This wide ranging approach was chosen in order to provide as much information as possible about the complex processes involved in the spread and implementation of a curriculum innovation through a nation.

A Synthesis of the Findings

In this section a brief resume of the findings of this study is presented. These findings are presented under three headings: the national level, the State level, and the school level. The implications of these results for improving the processes of dissemination, adoption, and implementation are also discussed.

The National Level Perspective

Data setting out the extent of adoption and reported use of ASEP by science departments indicated that the national level of acceptance of ASEP materials was high compared with similar science curriculum project materials in the United Kingdom (UK) (Booth, 1975), and the United States of America (USA) (Welch, 1976). Two out of every three secondary schools in Australia had obtained at least one ASEP module pack by February, 1976, less than two years after ASEP materials first became available. These results implied that most Australian science teachers knew about the ASEP development and the means by which its materials could be acquired.

This widespread adoption of ASEP led to extensive use of the materials in classrooms. A between-State analysis suggested that the extent of use reported by science teachers was strongly correlated with level of adoption. Adoption patterns showed that many schools built up their holdings of ASEP materials over time. This was possible because of the unitised nature of the ASEP texts. Thus, use of ASEP over time increased in many schools up to February, 1976. The national picture was therefore one of high impact. It is worth examining this finding in terms of the characteristics of the Project, and the prevailing educational conditions in Australia during the period of the ASEP development.

At the time of its inception, ASEP was a unique endeavour in Australian education. By contrast to the situation in the UK or the USA, where several rival science curriculum projects had been sponsored, ASEP was the sole national attempt to influence the schools' curriculum. It attracted the attention of educators in all fields, not only those concerned directly with science teaching. There was widespread knowledge of the Project's existence throughout each State system. As expected, system level science educators were particularly interested in the outcome of ASEP.

This interest percolated down to teachers via various sources, as well as from the Project team, through newsletters and other national agencies such as the national Science Teachers' Association. These sources created, during the period from 1969-1974, an expectancy amongst science teachers that great benefit would be derived by them and by their students from the use of ASEP's products. Consequently, when the ASEP materials were released, there was a high demand for the ASEP texts by the schools. This continued throughout 1975 and well into 1976 despite a cumbersome ordering system which, combined with unavailability of some unit texts, led to some frustration to schools wishing to use ASEP materials for the first time (Owen, 1978).

A major point of interest in the study was to examine how schools handled the problems of integrating ASEP materials into existing science programs. The national level data provided some important information about general trends in the schools. The data suggested that the schools concentrated their use of ASEP materials in part of their science programs at first, rather than to spread them across the total three or four-year curriculum. Schools introduced the majority of their adopted ASEP materials into science classes at lower year levels and, subsequently, obtained more for use at higher levels. This appeared to be a logical approach for it meant that students already studying science were subjected to a minimum of discontinuity which could have resulted from the introduction of the ASEP approach for the first time at higher year levels.

The patterns of adoption and use suggested that sudden large-scale changes to school science programs, to those based on ASEP units, did not often occur. There was an emphasis on gradualism, and the role of the science department in choosing units had implications for one aspect of curriculum change. The patterns of adoption of particular units showed that, at all stage levels, the most popular units were those with titles which suggested that they contained content related closely to the traditional physical and biological science areas. There was a strong association between the content most often chosen and the academic backgrounds of the science teachers. Cross-disciplinary titles, and those which implied an approach in which science could be integrated with other areas of the total school curriculum, were relatively unpopular. These results implied that many science courses in secondary schools in this country are a combination of sections based on traditional subject areas. This was subsequently borne out in visits to selected schools. This state of affairs exists despite encouragement by many State educational authorities for schools to adopt an integrated approach in their science programs. The ASEP developers had hoped that they, too, could influence teachers to incorporate social and environmental issues into their teaching through the use of appropriate ASEP units but, in general, this did not take place. This result has implications for future teacher education courses in this country if changes to science programs in sympathy with the ASEP philosophy are to be encouraged.

The State Level Perspective

At this level the emphasis in the investigation was on the roles of entities within each State which supported the ASEP development. It was found that explanations for the variation in adoption and use of ASEP ideas and materials in schools were associated with the extent to which these entities assisted teachers to plan school-based science programs based on new ideas in science teaching. Now, ASEP incorporated many ideas seen as fundamental to good science education for the 1970's and, in addition, it received financial support at its inception from all States. However, the results of between-States comparison of support strategies for ASEP led to two major conclusions. First, the general level of use of these support strategies across the three States examined was low. Secondly, there were variations in which of these strategies were used between States. These helped to explain the variation in adoption and reported use of the ASEP materials.

A possible interpretation regarding the first conclusion is that there was a widespread reaction against ASEP in its final form by agencies in the educational mediums. However, the evidence collected on visits to the States suggests that a more fundamental problem existed at the time of release of the ASEP products. This was that networks of support for school-based curriculum development had not been fully developed. An interpretation from the second conclusion is that there were variations in the extent of these networks. In some States new roles for curriculum advisers had not been worked out, and mechanisms had not evolved by which information about innovatory science materials could be disseminated.

The strategies which were associated with variations in adoption and use between States were:

the level of publicity given to ASEP in local science teachers' journals,

the extent to which ASEP trials were conducted during the development stage of the Project,

the availability and nature of guideline syllabuses in science, and

the activities of key individuals and groups which influenced the conduct of science programs in schools.

These strategies can be classified into two categories:

communication, and

pressures on norms and values of users.

Communication refers to the transmission of information about the innovation to users. Publicity accorded to ASEP through local science teacher journal articles can be allocated to this category.

The extent to which ASEP trials were conducted in a State during the ASEP developmental stage, the availability and nature of guidelines, and the activities of key individuals and groups which influenced the conduct of science programs in schools, are examples of system level pressures on user norms and values.

The trials conducted in each State allowed teachers to work through units in detail. The ASEP development team viewed these as being the most effective way of convincing potential users of the educational worth of the ASEP materials. The high correspondence found, during school investigations, between effective implementation and the presence of an ASEP trials' teacher in the school, suggests that this form of teacher re-education was effective. It was unfortunate, for protagonists of the ASEP approach, that the extent of trialling was not more widespread.

The other two strategies relate directly to system level support for school-based curriculum development. The degree of congruence between the 'ASEP approach' and the outline syllabus was an indication of the attitudes of influential system level agencies toward ASEP. The activities of key individuals and groups controlled the dissemination of curriculum materials by which the ideas of the outline syllabus could be implemented. When both of these strategies failed to encourage the ASEP rationale, there was a low penetration of ASEP materials into the schools in the State.

The preceding findings imply that a normative - re-educative approach to change needed to be adopted by an educational medium if the ASEP materials and ideas were to be widely used in schools. The effect of the ASEP development on school science programs was somewhat dependent on the educational medium in a State providing the opportunity for science departments to consider alternatives to their current teaching procedure. This interpretation highlights an important feature of curriculum change in Australia which is likely to apply elsewhere. That is, when an educational innovation's "fate" is evaluated, consideration must be given to influences of the educational medium in which the users are embedded. Curriculum innovations which are not given support by system level agents may continue for some time on the strength of the reputation of the developers but, ultimately, unless suitable communication and support frameworks are provided by the educational medium, the widespread use of the innovatory ideas and materials will decline.

The School Level Perspective

During investigations of the effects of ASEP at the school level, it was assumed that the science department was an organistic system possessing certain identifiable characteristics which affected the introduction and implementation of new curriculum methods and materials. A similar stance was taken to the one during the examination of educational medium effects: analyses of school level factors were undertaken on the assumption that schools were responsible for planning their science programs, and at the same time were free to select from a range of available approaches. To examine in greater detail how these things were accomplished, it was decided to adopt a process approach - selected schools were studied over time, using participant observation techniques.

There were large variations in the extent to which ASEP had been implemented in these schools. More importantly, there were variations in the ways in which science departments sought knowledge about the ASEP materials, considered this information, and then selected aspects of ASEP which would be useful to them in their course planning.

It was apparent that the quality of decision making about ASEP was associated with the climate for innovation in the science department. When there was a high climate for innovation, decisions about using ASEP materials were made in the light of clear objectives for the science program, a studied analysis of the local school facilities, and carefully developed ideas about how ASEP materials could be stored and developed for use in classrooms. The use of ASEP materials in these schools followed careful analysis of the potential of these materials. Some of the ASEP ideas were accepted, others were modified or adapted. In order for some of ASEP's characteristics to be implemented, teachers changed their methods of teaching but, in some respects, the changes were not to the extent that the ASEP developers envisaged. The net effect was one of mutual adaptation of user and innovation, a phenomenon noted elsewhere (Berman and McLaughlin, 1976). The important feature of the curriculum planning was that these modifications were made after the characteristics of ASEP had been fully understood and explored by the staff involved.

Where there was a low innovation climate, careful examination of ASEP ideas and materials did not take place prior to their use. Low innovative-high adopting schools reported teacher dissatisfaction with ASEP use. In these schools, insufficient attention had been given to the construction of a curriculum framework within which ASEP could be incorporated. Low innovative-low adopting schools were characterised by reliance on more traditional textual materials and methods of teaching, and a reluctance even to trial the ASEP approach. It was salutary to discover the existence of 'low innovative' schools, with their associated low level of professionalism, and the consequent problems which were associated with the incorporation of the ASEP materials into their science programs.

These results were gathered from intensive studies in a small number (13) of schools. However, the study also enabled State-level patterns of adoption and use of ASEP materials to be linked to school-level factors incorporated in the climate for innovation of the users. The analytic processes used to cluster schools on these sets of variables were a unique procedure which yielded helpful categorisations, from which links between implementation and school-level factors could be drawn. The similar cluster patterns found in the three States examined in detail suggested the generalisation that a link existed between 'successful' use of ASEP and the climate for innovation in the science department.

Whereas this study adopted a process approach to the investigation of implementation, it would also be possible to use fidelity measures of innovation, in which the implementation measures could be more strictly examined. The multidimensional nature of such implementation measures and also of the climate for innovation, implies that a multivariate technique such as canonical correlation might be appropriate.

Conceptualisations of Change

The ASEP development and its subsequent use in schools provided an opportunity for factors affecting its dissemination, adoption and implementation to be compared with theoretical paradigms which have been constructed to describe various methods of social change. Some of these models have been shown to be inaccurate in describing the most likely methods of change in schools. One, mentioned earlier in this chapter, is the Research, Development and Diffusion (R, D and D) approach (Clark and Guba, 1965). This model assumes that developers, using the results of basic and applied research, can undertake large scale planning and develop materials which then can be distributed to rational but passive users.

A major flaw in this paradigm for education is that the users are not passive; they play a major role in determining the success or otherwise of an innovation in the implementation stage. In a second approach, the Problem Solving Model (Lippitt et al, 1958), there is an assumption that schools can plan and execute their curricula within the local context with minimum recourse to external sources. Linkage agents and developments in 'funded knowledge' have little effect on curriculum programs developed along the lines of this paradigm. It is evident from these two brief descriptions that the paradigms represent extreme views regarding the control of curriculum. Whereas the R, D and D conceptualisation emphasises that, in order for change to occur, there must be new knowledge from outside user systems, the Problem Solving paradigm emphasises the social interactions and commitment of those within the school.

A more recent attempt to conceptualise the relationship between external and internal factors on implementing an innovation appears in the Linkage Model (Havelock, 1971). This model assumes that neither external agencies nor those in schools should completely determine the curriculum. A fundamental proposition of the Linkage Model is that a two-way interaction between users and system level agents should be set up, which will guarantee a continuous flow of information between the two sources. For this interaction to be most effective two aspects must occur. First, users must adopt an open attitude towards new knowledge and be prepared to use this knowledge in planning programs. Secondly, systems must respond to the needs of users when planning is undertaken by them, they must be capable of assisting with the solution of these problems, and have the capacity to feed these solutions back to users and assist with their implementation. When curriculum development is school based, the Linkage Model has particular appeal as a means of conceptualising ideal relationships between those in schools and those in the supporting systems.

Upon reflection on the impact of ASEP, there appeared to be one educational milieu which possessed the characteristics described in the Linkage Model; this was South Australia. It was also the State where the ASEP ideas and materials took root most firmly. It is worth considering this situation again in terms of the Linkage paradigm. In the State, science departments required suitable guidelines and materials for use in science courses. This need was fed back by teachers to appropriate medium level committees set up to offer solutions to problems in schools. These committees had access to experts and to a variety of material resources. In fact, ASEP was a major resource for schools to plan suitable science programs. South Australia also had mechanisms for disseminating solutions to schools through strong consultancy services. The creation of strong linkages between school and system also appeared to be associated with innovative conditions in the schools. There were indications that a larger proportion of the science departments had high or moderate climates for innovation. These conditions were conducive to the incorporation of ASEP into South Australian science programs.

Concluding Comments

It would be an over-simplification to make a general statement about the effect of ASEP on science curricula in Australian schools. That ASEP materials penetrated into so many schools across the country can be taken as heartening by those who launched, developed and promulgated it as a vehicle for change. But if implementation of ASEP's ideas through the use of the materials is taken as the criterion, a conclusion is that, in many schools, ASEP's impact was small or negligible. In certain schools, where ASEP materials had been obtained, they were not used. In others, where larger quantities had been obtained, implementation was 'impure';[1] there were great differences between practice and the guidelines suggested by the ASEP developers. This dissonance was associated with a lack of understanding of the basic aspects of the ASEP rationale.

Essential requirements associated with effectiveness of ASEP use by science departments were that the teachers were well organised and had an attitudinal receptivity towards change. The characteristics depended on teachers having an understanding of curriculum development, of curriculum implementation, and group decision making. It is when these characteristics are developed that teachers perceive the relevance of well produced curriculum materials and are able to put them into practice effectively.

Support services are also crucial, and in some States the system-level ones had little effect. The ASEP team recognised that some characteristics of their materials were radical and that widespread re-education of teachers was required if they were to assess the worth of ASEP. That the ASEP team was not able to implement a re-education program in conjunction with State authorities to inform science teachers appears, in retrospect, to have been unfortunate. However, where teachers benefitted from direct contact with ASEP through trials, ASEP materials were often well implemented in the schools. In general, it appears that systems must provide teachers with opportunities to assess innovations in curriculum, but in a manner which does not assume that they will necessarily be adopted.

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[1] Hall and Loucks (1979) have recently provided a valuable guide to the study of adaptation of innovations. A concept they have introduced is the 'purity of implementation', defined as: the ratio of the number of dimensions of the innovation observed to the number of dimensions in the model of the developer.

The dissemination and implementation of curriculum ideas and materials are challenging and complex issues. In a small way this research has contributed to the larger task of developing an understanding of the processes involved in curriculum change. The implementation of research findings such as these reported is fundamental to the improvement of school practice. Research into this aspect of implementation may, in the future, become as important as investigations into curriculum change itself.

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APPENDIX 5/1

STATISTICS RELATING TO THE SCALES OF THE INNOVATION CLIMATE TRIALS STAGE (BETWEEN-TEACHERS) (N=160)

Scale Name	Interaction	Organisation	Cooperation	Openness	Knowledge
Mean Score	27.0	20.4	17.5	14.9	5.5
Standard Deviation	5.9	4.7	5.2	3.6	2.2
Reliability (Coefficient α)	0.71	0.67	0.79	0.63	0.64
Number of Items	7	7	7	7	8

Range and Intercorrelation

	Range	Interaction	Organisation	Cooperation	Openness	Knowledge
Interaction	8-35	-	0.01	0.09	0.38	0.22
Organisation	8-34		-	0.38	0.11	0.04
Cooperation	7-33			-	0.15	-0.07
Openness	7-28				-	0.10
Knowledge of the Innovation	1-8					-

APPENDIX 5/2

THE TEACHER QUESTIONNAIRE

AUSTRALIAN COUNCIL FOR
EDUCATIONAL RESEARCH

SCIENCE CURRICULUM MATERIALS IN AUSTRALIAN SCHOOLS

ASEP EVALUATION STUDY
TEACHER QUESTIONNAIRE

Information given in response to this questionnaire is confidential to ACER and will be used only in making statistical calculations or for deriving general statements. No individual school or teacher will be identified in reports of these studies.

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Frederick Street, Hawthorn, Victoria, 3122.

NOTES FOR GUIDANCE IN COMPLETING THIS QUESTIONNAIRE

1. This questionnaire is directed to teachers of Science in the school. Science in in this context refers to science subjects offered in the school at years 7 - 10 and includes combined science, general science, physics, chemistry and biology, environmental science etc. taught at these levels. It does not include domestic science or geography.

2. Different designations of grade or year levels of secondary school are used in the various States and Territories of Australia. In this national questionnaire, it is necessary to use year description throughout. The equivalent State or Territory designation currently in use is shown in the following table.

Name used in this study	A.C.T.	N.S.W.	VIC.	TAS.	QLD.	S.A.	W.A.
Year 7	Form 1	Form 1	Form 1	First yr	-	-	-
Year 8	Form 2	Form 2	Form 2	Second yr	Grade 8	First yr	First yr
Year 9	Form 3	Form 3	Form 3	Third yr	Grade 9	Second yr	Second yr
Year 10	Form 4	Form 4	Form 4	Fourth yr	Grade 10	Third yr	Third yr
Year 11	Form 5	Form 5	Form 5	Fifth yr	Grade 11	Fourth yr	Fourth yr
Year 12	Form 6	Form 6	Form 6	Sixth yr	Grade 12	Fifth yr	Fifth yr

3. Space is available at the end of some questions to enable you to comment if you wish. Space is also available at the end of the questionnaire for any general comments you wish to make.

4. A report of the study will be sent to every school taking part in the project.

5. Please place the completed questionnaire in an envelope or return it as is, to the School Coordinator for the project, as soon as possible. THANK YOU FOR YOUR PARTICIPATION.

Office use only

SECTION 1 GENERAL INFORMATION

1:1-4

1. Name of the school: ______________________________ 1:5

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STRATUM ☐ 1:6-7
M/NM ☐ 1:8
G/1/C ☐ 1:9
SZ14 ☐ 1:10-11

SECTION I BIOGRAPHICAL DATA

2. Sex. (Tick one)

(a) Male ☐
(b) Female ☐ 1:12

3. Age. (Tick one)

(a) 22 years or younger ☐
(b) 23 - 24 years ☐
(c) 25 - 26 years ☐ 1:13
(d) 27 - 29 years ☐
(e) 30 - 40 years ☐
(f) 41 years or older ☐

4. Do you consider yourself to be a specialist teacher of Science? No ☐ Yes ☐ 1:14

5. How many years, including the present year, have you been teaching altogether? (Do not include time spent in training).

☐ yrs. 1:15-16

6. How many years, including the present year, have you been teaching in this school?

☐ yrs. 1:17-18

Office use only

7. How would you describe the content of your academic training? (Tick one)

(a) Primarily in the biological sciences ☐

(b) Primarily in the physical sciences ☐

(c) Primarily in the earth sciences ☐

(d) My academic training was at least partly in the sciences, but I did not specialise in any of the three areas described above. ☐

(e) Primarily in a field other than science ☐

1:19

8. Which of the following best describes the form of your post-secondary education. (Tick one)

(a) I have received no post secondary education. ☐

(b) College of Advanced Education (or Teachers' College), 3 year course or less. ☐

(c) College of Advanced Education (or Teachers' College), more than 3 year course. ☐

(d) University (pass or higher degree). ☐

(e) University (pass or higher degree) and teacher training outside a University. ☐

(f) University (pass or higher degree) and teacher training within a University. ☐

(g) University (pass or higher degree) and a second degree in education. ☐

1:20

9. In the table below, indicate the distribution of your teaching time by writing in the appropriate squares, the number of minutes you spend teaching different subjects throughout the school each week. (Take the first week in October if your allotment varied in 1975).

	Science	*Physics	*Chemistry	*Biology	Mathematics	Other subjects
Year 7						
Year 8						
Year 9						
Year 10						
Year 11						
Year 12						

1:21-23

1:24-26

1:27-29

1:30-32

* For this question only, treat Physics, Chemistry and Biology as separate subjects from Science in years 7 - 10.

Office use only

SECTION II - CURRICULUM MATERIALS

10. (Please answer this question only if you teach in ACT, NSW, Tasmania or Victoria).

Are you teaching Science (or a branch of science) at Year 7 level in 1975?

No ☐

Yes ☐ 1:33

11. If you answered yes to Question 10 please indicate in the table below, the extent to which you used* (see footnote) the following textbooks or curriculum materials in your teaching at Year 7 level in 1975. (Tick the appropriate box; if a particular textbook, or curriculum not used, leave both spaces blank).

	Equivalent of one term or more	Used, but less than one term	
(a) Activities in Science (Arnold and others)			1:34
(b) ASEP materials			1:35
(c) Concepts of Science (Cull and Drake)			1:36
(d) Discovery in Science (Eberhard and others)			1:37
(e) In search of Science (Russell and others)			1:38
(f) Introduction to Science (Boden and others)			1:39
(g) JSSP materials			1:40
(h) Modern Science A + B (Barrell)			1:41
(i) Nuffield materials (any)			1:42
(j) Science for High School Students (Messel)			1:43
(k) Science for Secondary Schools (Heading)			1:44
(l) Science for the 70's (Mee and others)			1:45
(m) State Education Dept. Materials			1:46
(n) 'Teacher made materials'			1:47
(o) Other(s) please specify			1:48

* 'Used' in this context means:

For Textbooks. The book was used regularly by the teacher and/or the students in science classes.

For Curriculum Materials. The materials were the major source from which your science teaching was derived.

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12. (Teachers in all States, please answer this question).

Are you teaching Science (or a branch of science) at Year 8 level in 1975?.

No ☐

Yes ☐ 1:49

13. If you answered yes to Question 12 please indicate in the table below, the extent to which you used* the following textbooks or curriculum materials in your teaching at Year 8 level in 1975. (Tick the appropriate box; if material not used, leave both spaces blank).

	Equivalent to one term or more	Used, but less than one term	
(a) Activities in Science (Arnold and others)			1:50
(b) ASEP materials			1:51
(c) Concepts of Science (Cull and Drake)			1:52
(d) Discovery in Science (Eberhard and others)			1:53
(e) In search of Science (Russell and others)			1:54
(f) Introduction to Science (Boden and others)			1:55
(g) JSSP materials			1:56
(h) Modern Science A + B (Barrell)			1:57
(i) Nuffield materials (any)			1:58
(j) Science for High School Students (Messel)			1:59
(k) Science for Secondary Schools (Heading)			1:60
(l) Science for the 70's (Mee and others)			1:61
(m) State Education Dept. Materials			1:62
(n) 'Teacher made materials'			1:63
(o) Other(s) please specify			1:64

* See footnote on page 5.

Office use only

14. (Teachers in all States, please answer this question).

Are you teaching Science (or a branch of Science) at Year 9 level in 1975?

No ☐ 1:65

Yes ☐

15. If you answered yes to Question 14 please indicate in the table below, the extent to which you used* the following textbooks or curriculum materials in your teaching at Year 9 level in 1975. (Tick the appropriate box; if material not used, leave both spaces blank).

	Equivalent to one term or more	Used, but less than one term	Office use only
(a) Activities in Science (Arnold and others)			1:66
(b) ASEP materials			1:67
(c) Concepts of Science (Cull and Drake)			1:68
(d) Discovery in Science (Eberhard and others)			1:69
(e) In search of Science (Russell and others)			1:70
(f) Introduction to Science (Roden and others)			1:71
(g) JSSP materials			1:72
(h) Modern Science A + B (Barrell)			1:73
(i) Nuffield Materials (any)			1:74
(j) Science for High School Students (Messel)			1:75
(k) Science for Secondary Schools (Heading)			1:76
(l) Science for the 70's (Mee and others)			1:77
(m) State Education Dept. Materials			1:78
(n) 'Teacher made materials'			1:79
(o) Other(s) please specify			1:80

* See footnote on page 5.

Office use only

16. (Teachers in all States, please answer this question). 2:1-4

Are you teaching Science (or a branch of Science) at Year 10 level in 1975? 2:5

No ☐ 2:6

Yes ☐

17. If you answered yes to Question 16 please indicate in the table below, the extent to which you used* the following textbooks or curriculum materials in your teaching at Year 10 level in 1975. (Tick the appropriate box; if material not used, leave both spaces blank).

	Equivalent to one term or more	Used, but less than one term	Office use only
(a) Activities in Science (Arnold and others)	☐	☐	2:7
(b) ASEP materials	☐	☐	2:8
(c) Concepts of Science (Cull and Drake)	☐	☐	2:9
(d) Discovery in Science (Eberhard and others)	☐	☐	2:10
(e) In search of Science (Russell and others)	☐	☐	2:11
(f) Introduction to Science (Boden and others)	☐	☐	2:12
(g) JSSP Materials	☐	☐	2:13
(h) Modern Science A + B (Barrell)	☐	☐	2:14
(i) Nuffield materials (any)	☐	☐	2:15
(j) Science for High School Students (Messel)	☐	☐	2:16
(k) Science for Secondary Schools (Heading)	☐	☐	2:17
(l) Science for the 70's (Mee and others)	☐	☐	2:18
(m) State Education Dept. Materials	☐	☐	2:19
(n) 'Teacher made materials'	☐	☐	2:20
(o) Other(s) please specify	☐	☐	2:21
	☐	☐	
	☐	☐	
	☐	☐	

* See footnote on page 5.

Office use only

The following questions refer to materials produced by the Australian Science Education Project (ASEP). Please answer the following questions regardless of whether you have or have not used ASEP materials in your teaching.

18. Which of the following describes the way you first learnt about ASEP (Tick one)?

(a) In an article in a journal, newspaper or newsletter. ☐
(b) From printed information from the ASEP developers. ☐
(c) At an Inservice training conference. ☐
(d) From a Science adviser or inspector. ☐
(e) From a teacher at another school. ☐ 2:22
(f) From a teacher in this school. ☐
(g) Through my teacher training. ☐
(h) Through my involvement in ASEP trials. ☐
(i) Other (please specify) ☐

---

19. When did you first use (in any way) ASEP materials in your classroom teaching (Tick one)?

(a) As a trial's teacher in the ASEP development. ☐
(b) Before the end of 1974. ☐
(c) Between January 1975 and May 1975. ☐ 2:23
(d) Between June 1975 and October 1975. ☐
(e) I have not used ASEP materials. ☐

20. What is your perception of Science Inspectors and/or Advisers to ASEP materials in the last two years (Tick one)?

(a) There has been an active promotion of ASEP by these officers; far more emphasis has been placed on ASEP than on other Science materials. ☐
(b) Science Advisers/Inspectors have adopted a neutral attitude to ASEP, treating these materials just like other curricula and texts. ☐ 2:24
(c) Science Advisers/Inspectors have promoted some other Science materials rather than ASEP. ☐
(d) Science Advisers/Inspectors have promoted other Science materials as well as ASEP. ☐
(e) I do not know the attitude of these officers. ☐

Office use only

21. Please answer this question only if you commenced teaching in 1973, 1974 or 1975.

To what extent did your University or College classes in your preparation to be a Science teacher refer to ASEP materials?

- (a) A range of curriculum materials were discussed, but ASEP was given more prominence than other Science curricula or textbooks. ☐
- (b) A range of curriculum materials were introduced, and ASEP was not given special prominence. ☐
- (c) A range of curriculum materials were introduced, but ASEP was not among them. ☐
- (d) There was no specific discussions about curriculum materials for Science in my teacher training. ☐

2:25

SECTION III PROPERTIES OF ASEP

In this section you are asked to answer some questions about ASEP materials. Please answer regardless of whether you have or have not used ASEP materials during your teaching career. For each question, indicate whether you agree or disagree with each statement. (Please respond to each question).

22. The ASEP program;

		Agree	Disagree	Office use only
(a)	attempts to cater for a wide range of reading abilities.	☐	☐	2:26
(b)	provides a clearly planned sequential course of science suitable for the first three years of secondary school.	☐	☐	2:27
(c)	provides printed materials only.	☐	☐	2:28
(d)	includes topics not usually found in Science, e.g. anthropological and sociological topics.	☐	☐	2:29
(e)	is structured to allow students to work in small groups.	☐	☐	2:30
(f)	includes clear directions on the way each class activity should be conducted.	☐	☐	2:31
(g)	allows students some choice of activities within units.	☐	☐	2:32
(h)	emphasises as a central theme, the fundamentals of science, measurement, approximation and classification.	☐	☐	2:33
(i)	includes in the units, tests which students can attempt during the unit.	☐	☐	2:34

Office use only

SECTION IV TEACHER ACTIVITIES

Please indicate the extent to which you have undertaken any of the following activities in relation to your teaching during the past two years, including this year, by ticking the appropriate column, for each question. (Please respond to each item).

23.

		4 or more	3	2	1	0
(a)	How many inservice courses (of one day's duration or greater than one day's duration) related to the use of ASEP materials have you attended?					
(b)	What is the total number of days you have spent at these courses?					
(c)	How many inservice courses (of greater than one day's duration) on aspects of your science teaching throughout the school other than the use of ASEP materials have you attended?					
(d)	What is the total number of days you have spent at these courses?					
(e)	How many visits have you made to another school to discuss with other teachers, problems relating to teaching the sciences?					
(f)	How many times have you attended a local (regional) meeting of science teachers where matters relating to science teaching were discussed?					
(g)	How many seminars or lectures (of a day's duration, or less) have you attended relating to aspects of science education which have been organised on a state-wide basis?					
(h)	How many times has there been a visit to the science department of your school of an official whose role was of an advisory nature with respect to science teaching?					
(i)	How many journals do you personally subscribe to which relate to aspects of science teaching (e.g. Australian Science Teachers' Journal, New Scientist, Scientific American, Physics Today?)					

2:35
2:36
2:37
2:38
2:39
2:40
2:41
2:42
2:43
2:44

SECTION V SCHOOL ORGANIZATION

This section of the questionnaire is concerned with teachers' opinions about a variety of facets of the organization of the science department in the school in which you teach. You are asked to think carefully about each statement and express the extent of agreement or disagreement with each statement by placing a tick in the appropriate column. PLEASE RESPOND TO THE ITEMS IN TERMS OF WHAT ACTUALLY HAPPENS AT YOUR SCHOOL, NOT WHAT YOU THINK SHOULD HAPPEN. (Please respond to each item).

24.	Strongly Agree	Agree	Disagree	Strongly Disagree	Neutral	Office use only
(a) Lack of experience among the members of the science staff makes the smooth running of the science department difficult.						2:45
(b) I often read articles about new approaches to science teaching.						2:46
(c) Science teachers at this school are a close knit group.						2:47
(d) When this department decides on a plan of action, it is rarely carried through.						2:48
(e) More inexperienced science staff get little help from other science teachers.						2:49
(f) The science department at this school rarely has meetings where mutual problems are discussed.						2:50
(g) There is plenty to be learnt from talking to science advisers.						2:51
(h) Laboratory assistants or other ancillary staff (such as the librarian) are a great help to science teachers in this school.						2:52
(i) All members of the science staff know each other very well.						2:53
(j) The school timetable does not provide suitable scheduling for effective science teaching.						2:54
(k) It is not worth the extra effort to keep abreast of new developments in science, by reading books and journals and attending lectures.						2:55
(l) Decisions about the choice of science textbooks are generally made after discussing involving all members of the department.						2:56

	Strongly Agree	Agree	Disagree	Strongly Disagree	Neutral	Office use only
(m) In this school, it is difficult to cope with the practical problems of teaching science.						2:57
(n) It is challenging to try out new textual science materials.						2:58
(o) Decisions about the purchase of new equipment and apparatus are rarely made by the science department as a group.						2:59
(p) When stored apparatus and printed materials are required, they are easy to locate.						2:60
(q) One should guard against getting out of touch with the important results of educational research which affect science teaching.						2:61
(r) The laboratories in this school are well designed for teaching science.						2:62
(s) It is not really useful to go to lectures or inservice training courses, when one considers the real problems at classroom level.						2:63
(t) Science teachers here are generally aware of what other science teachers are teaching.						2:64
(u) The school buildings are such that there are sufficient laboratories for the teaching of science.						2:65

SECTION VI REACTION TO ASEP MATERIALS

This section of the questionnaire is concerned with the perceptions of science teachers about ASEP materials. You are asked to think carefully about each statement and express the extent of your agreement or disagreement with each statement by placing a tick in the appropriate column. 2:66

ANSWER THIS SECTION ONLY IF YOU HAVE ACTUALLY USED THE ASEP MATERIALS IN YOUR TEACHING. ("Used" in this respect should be broadly interpreted - from 'used as resource texts for a series of lessons' to 'used in student centred inquiry teaching'). **IF YOU HAVE NOT USED ASEP MATERIALS GO ON TO SECTION VII (COMMENTS).**

25.

	Strongly Agree	Agree	Disagree	Strongly Disagree	Neutral	Office use only
(a) I find it impossible to adapt the ASEP materials for use with students who are not usually interested in science.						2:67
(b) The effort involved in using an ASEP unit outweighs any benefit the students gain from a different approach to learning.						2:68
(c) In general, less able students have little difficulty reading the student texts.						2:69
(d) When I use ASEP materials, most students enjoy science.						2:70
(e) I have had problems using the ASEP units because students become bored if a unit continues for more than three weeks.						2:71
(f) I find it difficult to modify the ASEP units for use in the particular physical conditions under which I teach science.						2:72
(g) It is difficult to match up students' abilities to the various activities in an ASEP unit.						2:73
(h) The ASEP units are of value because they can be used in a variety of ways to teach science.						2:74
(i) ASEP materials are too fragmented to be used as a basis for the Science course I wish to teach.						2:75
(j) Having to scrounge around for additional apparatus not supplied by ASEP often causes delays in implementing and using a unit.						2:76
(k) By having most units independent of each other, there is greater freedom for me to plan my Science teaching in the way I wish.						2:77
(l) In teaching Science, I would place greater emphasis on achievement than is provided by the ASEP materials.						2:78
(m) The ASEP units can be readily interspersed with other science teaching materials.						2:79
(n) Using ASEP material is rewarding because it has greatly improved the attitudes of many students who were previously not interested in science.						2:80

	Strongly Agree	Agree	Disagree	Strongly Disagree	Neutral	Office use only
						3:1-4 3:5
(o) I believe that it is appropriate for ASEP to have included units which involve content outside the traditional areas of physics, chemistry, biology and earth sciences.						3:6
(p) ASEP units are just what I need to provide students with some choice in what they learn.						3:7
(q) The ASEP materials are easily adaptable for use with slower learners.						3:8
(r) By allowing students to study what interests them, the "option system", although imposing heavy demands on the teacher, is worth the effort.						3:9
(s) In teaching Science, I would place less emphasis on student activity and involvement than the ASEP materials try to encourage.						3:10
(t) Once an ASEP unit is underway in a class, there are still too many chores for a teacher to do, and student enquiries are then neglected.						3:11
(u) In the ASEP materials, there is not enough challenging work for the more able pupils.						3:12
(v) Insufficient instructions are given on how each part of a unit should be used.						3:13
(w) I think that, in teaching Science, it is necessary to provide opportunities for students to do things which interest them, as ASEP have done.						3:14
(x) In general, I have more cordial relations with students I teach in science, as a result of using ASEP.						3:15
(y) The difficulty in reading ASEP texts makes student centred learning an impossibility in my classes.						3:16
(z) One advantage of having ASEP materials in the school is that it has enabled me to cater for students working at different rates in science.						3:17
(aa) Once an ASEP unit has begun, I believe it is unsatisfactory to discontinue its use before most students have tried all the options.						3:18
(bb) It is not difficult to assess the progress of individual students when ASEP materials are being used.						3:19

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SECTION VII COMMENTS

If you have any comments regarding any aspect of factors which have been covered in this questionnaire, please write them below.

	3:20
	3:21
	3:22
	3:23
	3:24
	3:25

PLEASE RETURN THIS QUESTIONNAIRE AS SOON AS POSSIBLE FOLDED IN AN ENVELOPE, OR AS IS TO THE SCHOOL COORDINATOR FOR THE PROJECT. THANK YOU VERY MUCH FOR YOUR HELP.

APPENDIX 5/3

THE SCHOOL QUESTIONNAIRE

AUSTRALIAN COUNCIL FOR
EDUCATIONAL RESEARCH

SCIENCE CURRICULUM MATERIALS IN AUSTRALIAN SCHOOLS

ASEP EVALUATION STUDY
SCHOOL QUESTIONNAIRE

(To be completed by the TEACHER IN CHARGE OF SCIENCE)

Information given in response to this questionnaire is confidential to ACER and will be used only in making statistical calculations or for deriving general statements. No individual school will be identified in reports of these studies.

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Australian Council for Educational Research
Frederick Street, Hawthorn, Victoria, 3122.

NOTES FOR GUIDANCE IN COMPLETING THIS QUESTIONNAIRE

1. Different designations of grade or year levels of secondary school are used in the various States and Territories of Australia. In this national questionnaire it is necessary to use year descriptions throughout. The equivalent State or Territory designation currently in use is shown in the following table.

Name used in this study	A.C.T.	N.S.W.	VIC.	TAS.	QLD.	S.A.	W.A.
Year 7	Form 1	Form 1	Form 1	First yr	-	-	-
Year 8	Form 2	Form 2	Form 2	Second yr	Grade 8	First yr	First yr
Year 9	Form 3	Form 3	Form 3	Third yr	Grade 9	Second yr	Second yr
Year 10	Form 4	Form 4	Form 4	Fourth yr	Grade 10	Third yr	Third yr
Year 11	Form 5	Form 5	Form 5	Fifth yr	Grade 11	Fourth yr	Fourth yr
Year 12	Form 6	Form 6	Form 6	Sixth yr	Grade 12	Fifth yr	Fifth yr

2. Where reference is made to 'studying a science subject' it includes the study of Science (multistrand, combined or general), any one or more of Physics, Chemistry, Biology, Human Biology, or Geology, Agricultural or Rural Science, Environmental Science, or science taken as part of General Studies program. It does not include Domestic Science or Geography.

3. In answering some sections of the questionnaire you may need to consult
   (i) enrolment details
   (ii) the school timetable.

4. Space is available at the end of some questions to enable you to comment if you wish. Space is also available at the end of the questionnaire for any general comments you wish to make.

5. Please collect the Teacher Questionnaire from other members of staff, and post both School and Teacher Questionnaires to:

Mr J. Owen
Project Officer (ASEP)
Australian Council for Educational Research
PO Box 210
Hawthorn, Victoria, 3122.

A report of the study will be sent to every school taking part in the study. An early return would be most appreciated.

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SECTION 1 GENERAL INFORMATION

1. Name of the school: ______________________________ 1:1-4

2. Name of person completing questionnaire: ______________________ 1:5

3. Does your school have a nearly uniform length teaching period throughout the week?

NO ☐ 1:6

YES ☐

If YES

4. What is the length of a teaching period (in minutes)? ☐ 1:7-8

5. How many such periods make up the teaching week? (i.e. How many such periods comprise the timetable for the week's activities?) ☐ 1:9-10

If NO briefly describe the pattern of teaching periods which operates throughout the week.

____

____

____

____

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STRATUM 1:11-12

M/NM 1:13

G/I/C 1:14

SZ14 1:15-17

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SECTION II **SCIENCE TEACHING PROGRAM**

6. How many separate groups (classes) are taken for science subjects each of the following grade levels?

(a)	Year 7.	☐	1:18-19
(b)	Year 8.	☐	1:20-2
(c)	Year 9.	☐	1:22-23
(d)	Year 10.	☐	1:24-25

7. Indicate the way students are allocated to classes in Science (or in separate science subjects) at the following year levels.

	All classes are structured so that they contain students with a wide range of general abilities	Some classes contain students with a wide range of abilities, other classes contain students of more similar abilities	Classes are structured so that students of similar abilities are grouped together in any one class	
Year 7				1:26
Year 8				1:27
Year 9				1:28
Year 10				1:29

8. For each separate class group of these Year levels, how many Science periods are taken each week?

Note: (1) If your school does not plan its timetable on a standard length teaching period enter the replies as the amount of time each week spent in science classes (in minutes to the nearest 10 minutes).

(2) Include any extra classes of science based elective studies held in addition to the normal science program.

CLASS GROUP	1	2	3	4	5	6	7	8	9	10	11	12	
Year 7													1:30
Year 8													1:31
Year 9													1:32
Year 10													1:33

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9. For each year level, indicate the way in which studies in Science are arranged in 1975.

	Students study science as one subject for the whole year	Students study science as one subject for part of the year, and as separate subjects such as Physics and Environmental Science for the rest of the year	Students study science as a group of separate subjects, such as Physics and Environmental Science for the whole year	
Year 7				1:34
Year 8				1:35
Year 9				1:36
Year 10				1:37

10. How many full-time equivalent non-teaching assistants (e.g. laboratory assistants) are there on the science staff?

☐ 1:38

11. How many rooms at your school are equipped for and principally used for science teaching?

☐ 1:39-40

12. How many science rooms were built or refitted using the Commonwealth Science Scheme?

☐ 1:41

13. How many science periods are taken in rooms not equipped for science teaching?

(a) In grades 7 to 10 inclusive. ☐ 1:42-43

(b) In grades 11 and 12. ☐ 1:44-45

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SECTION III ENROLMENTS

14. How many students are enrolled in each of the Year levels listed below? (Note: if precise information is hard to obtain please give an approximate figure).

(a) Year 7.		1:46-48
(b) Year 8.		1:49-51
(c) Year 9.		1:52-54
(d) Year 10.		1:55-57
(e) Year 11.		1:58-60
(f) Year 12.		1:61-63

15. How many students in each of the Year levels listed below study a science subject? If all students at any Year level study a science subject write ALL.

(a) Year 7.		1:64-66
(b) Year 8.		1:67-69
(c) Year 9.		1:70-72
(d) Year 10.		1:73-75

16. Please indicate the number of students in Year 12 studying each of the following areas.

(a) Chemistry.		1:76-78
(b) Biology.		2:6-8
(c) Physics.		2:9-11

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SECTION IV CURRICULUM MATERIALS FOR SCIENCE TEACHING

Did the teacher who had overall charge of the science department of the school teach Science (or one of the separate science subjects) at any of the years 7-10.

17. In 1974? 2:12

No ☐

Yes ☐

18. In 1975? 2:13

No ☐

Yes ☐

19. Has the school in which you teach received and paid for any ASEP materials up to 1 October 1975 (tick one)? 2:14

(a) Yes, the school owns inspection packs and module packs ☐

(b) Yes, the school owns inspection packs only ☐

(c) No ☐

20. Has the school used ASEP materials in Science classes up to 1 October 1975? 2:15

No ☐

Yes ☐

IF THE ANSWER TO QUESTION 20 IS NO, PLEASE ANSWER QUESTION 21. IF THE ANSWER TO QUESTION IS YES, PLEASE SKIP QUESTION 21 AND GO ON TO QUESTION 22.

21. A number of circumstances are reported as 'barriers' to adopting new materials. In your experience, how important is each of the following in determining why the Science Department has not used ASEP in Science classes up to now. (Please answer all questions).

		Extreme	Major	Moderate	Slight	None	Office use only
(a)	Lack of adequate contacts with outside groups with expertise in knowledge of ASEP						2:16
(b)	Lack of communication among Science staff						2:17
(c)	Confusion among staff about the structure of ASEP's materials						2:18
(d)	Staff's lack of precise information about the way ASEP is distributed						2:19
(e)	Disorganization in the Science Department due to high staff turnover						2:20
(f)	Unwillingness of external resource groups to help us revise or adapt our teaching methods						2:21
(g)	Rigidity of school system structure and bureaucracy						2:22
(h)	Unwillingness of Science teachers in the school to listen to new ideas						2:23
(i)	Shortage of funds in the Science department						2:24
(j)	Shortage of teaching personnel in Science department						2:25
(k)	Feeling by staff that teaching ASEP would have little benefit for them						2:26
(l)	Lack of contact with other schools which had considered the same innovation						2:27
(m)	Lack of co-operation between the Science department and other groups of subject teachers with the school						2:28
(n)	Another set of textbooks seen as more suitable materials for students attending the school						2:29
(o)	School already committed to another set of textbooks or curriculum materials and that inclusion of ASEP was not worth the effort involved						2:30
(p)	Inadequacy of school laboratories, storage space, etc.						2:31
(q)	Feeling by staff that the ASEP materials would have little benefit for students						2:32

GO DIRECT TO SECTION V. (COMMENTS)

22. Indicate the relative importance of each of the following reasons why ASEP materials were first purchased in the school. (Please answer each question).

	Extreme	Major	Moderate	Slight	None	Office use only
(a) A teacher or group of teachers were impressed by the attempt to base a science course on a theory of intellectual development.						2:33
(b) The Science Department or those concerned with teaching science felt that the ASEP materials offered a chance to implement student centred science activities.						2:34
(c) The Science Department or those concerned with teaching Science were influenced by favourable impressions of the materials reported by an ASEP trials teacher, who was teaching in the school when the units became available.						2:35
(d) The Science Department or those concerned with teaching Science were influenced by a favourable trial of materials in the school.						2:36
(e) There was a need to purchase new Science materials, and some ASEP materials were considered appropriate for our purposes.						2:37
(f) Money, which had to be spent quickly was available at the time ASEP materials became available.						2:38

THE REMAINING QUESTIONS IN THIS SECTION APPLY SPECIFICALLY TO THE USE OF ASEP MATERIALS IN YOUR SCHOOL. PLEASE ANSWER THEM IF YOU ANSWERED BY TICKING (a) OR (b) IN QUESTION 19. IF YOU TICKED (c) (NO) IN QUESTION 19, GO ON TO SECTION V. (COMMENTS).

Office use only

23. What are the source(s) of funds for the purchase of ASEP materials? (Tick one or more).

ASEP is financed:

(a) out of general school running costs	☐	2:39
(b) out of science department running costs financed by the school	☐	2:40
(c) from levies on students	☐	2:41
(d) from the sale of record books to students	☐	2:42
(e) out of a grant by some government fund	☐	2:43
(f) other	☐	2:44

24. ASEP Inspection Packs contain a teacher edition, a record book and in some cases, other visual aid material.

(a) How many ASEP Inspection Packs were purchased by the school up to 31 December 1974?		2:45
(b) How many ASEP Inspection Packs were purchased by the school in the period between 1 January 1975 and 1 October 1975?		2:46
(c) How many ASEP Inspection Packs do you estimate will be purchased by the school between 1 October 1975 and 1 February 1976?		2:47

25. ASEP Module Packs contain 10 student books, 10 record books and in some cases, assorted items.

(a) How many ASEP Module Packs were purchased by the school up to 31 December 1974?		2:48
(b) How many ASEP Module Packs were purchased by the school in the period between 1 January 1975 and 1 October 1975?		2:49
(c) How many ASEP Module Packs do you estimate will be purchased by the school between 1 October 1975 and 1 February 1976?		2:50

26. Cost of ASEP materials. (If accurate figures are unavailable please approximate).

(a) How much was spent on the purchase of ASEP materials up to the end of 1974?	$	2:51-52
(b) How much was spent on the purchase of ASEP materials between 1 January 1975 and 1 October 1975?	$	2:53-54
(c) How much expenditure is planned for the purchase of ASEP materials between 1 October 1975 and 1 February 1976?	$	2:55-56

Office use only

27. Have ASEP Module Packs been used in the following subjects?

			Office use only
(a) General studies	No	☐	2:57
	Yes	☐	
(b) Geography	No	☐	2:58
	Yes	☐	
(c) Social studies	No	☐	2:59
	Yes	☐	
(d) Any other subject (apart from science)	No	☐	2:60
	Yes	☐	

28. Please indicate the extent to which the unavailability of ASEP materials has affected its use in the school in the last two years. (Tick the most appropriate alternative for each year).

	1974	1975	Office use only
(a) Unavailability of materials seriously affecting our planning	☐	☐	
(b) The problem of uncertain supply caused frustrations, and our use of ASEP materials in science was/is less than at first planned	☐	☐	2:61
(c) There have been only minor inconvenience as a result of unavailability.	☐	☐	2:62
(d) Our planned use of ASEP has not been affected by the unavailability of units	☐	☐	
(e) We did not contemplate the use of ASEP materials in this year	☐	☐	

29. Listed below are the units produced by the ASEP developers. Please indicate the total number of module packs for each unit which were in the school on 1 October 1975 (leave blank if zero).

Unit Number	Unit Name	Number of Module Packs	Office use only
101	Cells, the unit of life		3:6
102	Earths changing face		3:7
103	Electric circuits		3:8
104	Energy and change		3:9
105	Forces		3:10
106	Made to measure		3:11
107	Males and females		3:12
108	Mice and men		3:13
109	Minerals and crystals		3:14
110	Pigments and acidity		3:15
111	Places for people		3:16
112	Plants		3:17
113	Safety in science		3:18
114	Tuning in with the senses		3:19
115	Water		3:20
116	World of the soil		3:21
201	Atoms		3:22
202	Charge		3:23
203	Digging up evidence		3:24
204	Food		3:25
205	Life in freshwater		3:26
206	Light forms images		3:27
207	Machines		3:28
208	Microbes		3:29
209	Petroleum		3:30
210	Signals without words		3:31
211	Skin and clothes		3:32
212	Sticking together		3:33
213	Weather		3:34

Office use only

Unit Number	Unit Name	Number of Module Packs	Office use only
301	Australians past and present		3:35
302	The Australian Scene		3:36
303	The Earth		3:37
304	Genetics		3:38
305	How many people?		3:39
306	The human machine		3:40
307	Metals		3:41
308	Polymers		3:42
309	Seashores		3:43
310	Solar energy		3:44
311	Traffic		3:45
312	Where did humans come from?		3:46
151	Graphing, avging and reading scale		3:47
152	Heat and temperature		3:48
153	Keeping small mammals		3:49
154	Making photos		3:50
155	Density and pressure		3:51
156	Using a microscope		3:52

SECTION V COMMENTS

If you would like to make any additional comments about any of the aspects covered by the section of this questionnaire, write those comments in the space below. You may wish to comment on facilities for teaching science, on curriculum resources, or upon teaching methods or staffing. This section is entirely optional.

THANK YOU FOR YOUR ASSISTANCE.

APPENDIX 5/4

SUMMARY OF QUESTIONNAIRE RETURN RATES

Explanatory letters to schools - Sept 1975

Number of questionnaire sets sent out - 289

State	Explanatory letters to schools				Return rates as a function of time				
	Sent	Agreed	Agrd ACER foll. up	Dis-agree	Sent	28.11	8.12	19.12	Total 5.1.76
ACT	21	15	5	1	20	11	14	17	18
NSW	50	41	9	-	50	34	42	43	43
Vic.	50	47	2	1	49	23	33	45	45
Qld	50	39	11	-	50	36	44	48	49
SA	46	38	7	1	45	30	34	41	42
WA	39	32	7	-	39	27	31	33	36
Tas.	37	23	13	1	36	20	23	32	34
	293	235	54	4	289	181	221	259	267

Final statistics

State	No.of sch. Q's	No.of tchr Q packs	Total tchrs	% Schl. resp.	% Tchr resp.	Tchrs/Schl
ACT	18	18	137	90	90	7.6
NSW	42	43	249	84	86	5.9
Vic.	44	45	234	90	92	5.2
Qld	49	49	329	98	98	6.7
SA	42	42	290	93	93	6.9
WA	35	36	243	90	92	6.8
Tas.	33	34	217	92	94	6.4
	263	267	1699	91	92	6.4

No. of original agreeing schools not returning Q's - 11

No. of follow-up agreeing schools not returning Q's - 11

22

Executive
[illegible]

Director
[illegible]

Associate Directors
[illegible]

Australian Council for Educational Research
PO Box 210 Hawthorn
Victoria Australia 3122
Telephone 81 1271
Cables Acceres Melbourne

ASEP/75.133

APPENDIX 5/5

DIRECTIONS FOR THE SCHOOL CO-ORDINATOR FOR THE ASEP EVALUATION PROJECT

CO-ORDINATION OF SCIENCE MATERIALS SURVEY (ASEP EVALUATION)

The Australian Council for Educational Research is currently involved in a two year study of the use of science curriculum materials in Australian schools. One phase of the study is the collection of data from about 250 schools throughout the country.

The project is supported by the Australian Science Teachers' Association and a letter from Dr Greg Ramsey, President of ASTA is attached to this letter.

Recently, the Principal of your school agreed to its participation in the study titled 'ASEP Evaluation', and your name has been forwarded as the School Co-ordinator for the project. Enclosed are the survey materials which have been prepared so that data can be collected from science teachers in your school. Note that the questionnaires have been titled 'Science Curriculum materials in Australian Schools' and subtitled 'ASEP Evaluation Study', because the investigation is concerned with other aspects of Science teaching besides the use of ASEP materials.

Would you kindly carry out the following procedures in relation to the documents.

1. Distribute a teacher questionnaire (white booklet) to every science teacher in the school and arrange for the completed form to be returned to you as soon as possible.

> In ACT, NSW, Tasmania and Victoria a science teacher is defined for this study as a person who is currently teaching at least one class grouping at one or more of the first four year levels of secondary school.

> In South Australia, Queensland and West Australia, a science teacher is defined for this study as a person who is currently teaching at least one class grouping at one or more of the first three year levels of secondary school.

The teacher may return it as it is, or in an envelope to the school co-ordinator. If for any reason, a science teacher cannot fill in the questionnaire, please return it unanswered. HOWEVER, THE STUDY WILL HAVE MAXIMUM VALIDITY ONLY IF ALL SCIENCE TEACHERS IN THE SELECTED SCHOOLS COMPLETE THE QUESTIONNAIRE.

2. Ensure that the school questionnaire (blue booklet) is completed by the Science-co-ordinator, or a deputy.

3. In some cases, the Science-co-ordinator will also be a science teacher (as defined in 1.). It would be of great assistance if a teacher in this category fills in both questionnaires, but if this is too onerous, we will be pleased to receive only a completed school questionnaire from such a person.

4. Complete the attached return sheet which will be used at ACER for clerical purposes.

5. Place the completed (and any uncompleted) forms in the stamped and addressed envelope or jiffy bag provided and post to ACER, on or before Friday 14 November 1975.

AS YOU CAN APPRECIATE, IT IS OF UTMOST IMPORTANCE THAT ALL QUESTIONNAIRES BE RETURNED BEFORE THE SCHOOL YEAR FINISHES.

All schools taking part in the survey will receive a report of the results during 1976.

If there is a need to approach ACER about any aspect of the survey, please contact :

Mr John Owen,
Project Officer,
ASEP Evaluation,
ACER, PO Box 210,
Hawthorn, Victoria 3122
Phone - 03/81 - 1271

THANK YOU FOR YOUR ASSISTANCE.

APPENDIX 5/6

CONFIRMATION OF SCALES UNDERLYING VIEW STATEMENTS

(Between teachers. N=1699. Varimax Rotation.)

Variable	Factor 1	Factor 2	Factor 3	Factor 4
INT 1		49		
INT 2		65		
INT 3		68		
INT 4		71		
INT 5		63		
INT 6		39		
INT 7		57		
ORG 1				33
OPE 1		(41)	36	
CO-OP 1	61			
ORG 2				59
CO-OP 2				(61)
CO-OP 3	66			
OPE 2			48	
OPE 3	(33)			
CO-OP 4	61			
ORG 3				57
OPE 4			58	
CO-OP 5	56			
ORG 4				66
OPE 5			60	
CO-OP 6	52			
ORG 5				40
OPE 6			69	
ORG 6				68
OPE 7			59	
CO-OP 7	50			
ORG 7				68

Note: Decimal points omitted. Only factor loadings over 0.30 are shown. Loadings in brackets are those of items loading on the 'wrong' factor. INT - interaction; ORG - organization; CO-OP - co-operation; OPE - openness Items CO-OP2 and OPE3 deleted before scale scores calculated.

APPENDIX 5/7

CORRELATION OF ITEMS FOR EACH SCALE OF INNOVATION CLIMATE

(BETWEEN TEACHERS) (N=1699)

Scale: Organisation:

The extent to which resources and facilities made available by the school are effectively deployed by the science department.

	Item-Total Correlation
Lack of experience among the members of the science staff makes the smooth running of the science department difficult.	0.28
When this department decides on a plan of action it is rarely carried through.	0.27
The school timetabling does not provide suitable scheduling for effective science teaching.	0.36
In this school it is difficult to cope with the practical problems of teaching science.	0.49
When stored apparatus and printed materials are required, they are easy to locate.	0.37
The laboratories in this school are well designed for teaching science.	0.41
The school buildings are such that there are sufficient laboratories for the teaching of science.	0.31
Standardised α Reliability	0.68

Scale: Cooperation:

The extent to which staff of the science department assist each other in the day-to-day functioning of the department, and the degree to which decisions are made which involve the science department as a whole.

	Item-Total Correlation
Science teachers at this school are a close-knit group.	0.45
The science department at this school rarely has meetings where mutual problems are discussed.	0.45
All members of the science staff know each other very well.	0.46
Decisions about the choice of science textbooks are generally made after discussion involving all members of the department.	0.39
Decisions about the purchase of new equipment are rarely made by the science department as a group.	0.39
Science teachers here are generally aware of what other science teachers are teaching.	0.37
Standardised α Reliability	0.77

Scale: Openness:

The extent to which the science department expresses a willingness to find out about new developments, a willingness to be helped and a desire to change.

	Item-Total Correlation
I often read articles about new approaches to science teaching.	0.27
There is plenty to be learned from talking to science advisers.	0.25
It is not worth the extra effort to keep abreast of new developments in science by reading books and journals and attending lectures.	0.39
It is challenging to try out new textual science materials.	0.35
One should guard against getting out of touch with the important results of educational research which affect science teaching.	0.41
It is not really useful to go to lectures or inservice training courses, when one considers the real problems at classroom level.	0.33
Standardised α Reliability	0.64

Scale: Interaction:

The extent to which the science department is linked to other users - to others with greater knowledge of trends in curriculum development.

During the past two years:	Item-Total Correlation
How many inservice courses (of one day's duration or greater than one day's duration) related to the use of ASEP materials have you attended?	Unused stem for introducing next statement
What is the total number of days you have spent at these courses?	0.33
How many inservice courses (of greater than one day's duration) on aspects of your science teaching throughout the school other than the use of ASEP materials have you attended?	Unused stem for introducing next statement
What is the total number of days you have spent at these courses?	0.48
How many visits have you made to another school to discuss with other teachers, problems relating to teaching the sciences?	0.49
How many times have you attended a local (regional) meeting of science teachers where matters relating to science teaching were discussed?	0.53
How many seminars or lectures (of a day's duration, or less) have you attended relating to aspects of science education which have been organised on a State-wide basis?	0.46
How many times has there been a visit to the science department of your school of an official whose role was of an advisory nature with respect to science teaching?	0.27
How many journals do you personally subscribe to which relate to aspects of science teaching (e.g. Australian Science Teachers' Journal, New Scientist, Scientific American, Physics Today)?	0.59
Standardised α Reliability	0.74

APPENDIX 5/8

WEIGHTING CALCULATIONS TO ESTIMATE NATIONAL VALUES

Corrections to the values of variables were made in two stages:

1 Within States, to correct for non-response in each strata.

2 Between States, to correct for variations in the ratio: total number of schools/number of schools in the sample.

Between-State Corrections - 'Stateweights'

The differences outlined in (2) were calculated by using enrolments of 14-year-old students in all States.

Total Number of 14-year-olds Enrolled in Australian Schools

June 1975 240 885:

State	No. of schools drawn in each state sample[a] (A)	No. of 14-y.o. in State	State proportion of 300 schools based on 14-y.o. enrolments (B)	Correction ('stateweight') B/A
ACT	21	3 249	4.05	0.193
NSW	50	83 010	103.7	2.07
Vic.	50	65 620	82.0	1.64
Qld	50	36 216	45.3	0.906
SA	50	24 113	30.1	0.602
WA	40	20 517	25.6	0.640
Tas.	40	8 160	10.2	0.255
	301	240 885	301.0	

[a] Because of technical difficulties in drawing the sample, only 293 schools were actually used in the survey.

Weights Applied to Each Stratum to Correct for Non-Response and the Variations of Stateweights

State	Stratum number	No. of schools drawn in each stratum (N)	No. used in data analysis (n)	Correction for non-response N/n	Stateweights S	Final weighting $S(\frac{N}{n})$
ACT	43	13	12	1.08	0.193	0.209
	47	8	6	1.33		0.257
NSW	01	23	17	1.35	2.07	2.80
	02	16	15	1.07		2.21
	04	1	1	1.00		2.00
	05	7	6	1.17		2.42
	06	3	3	1.00		2.07
Vic.	07	24	22	1.09	1.64	1.79
	08	14	13	1.08		1.77
	11	9	7	1.29		2.11
	12	3	1	3.00		4.92
Qld	13	15	14	1.07	0.906	0.969
	14	23	22	1.05		0.951
	17	6	6	1.00		0.906
	18	6	6	1.00		0.906
SA	19	29	23	1.26	0.602	0.758
	20	14	14	1.00		0.602
	23	7	5	1.40		0.843
WA	25	22	21	1.05	0.640	0.672
	26	11	9	1.22		0.781
	29	7	4	1.75		1.12
Tas.	31	11	8	1.38	0.255	0.351
	32	23	20	1.15		0.293
	35	3	2	1.50		0.383
	36	3	3	1.00		0.255

APPENDIX 5/9

INTERVIEW SCHEDULE USED ON SCHOOL VISITS

Section I. (Heads of Science only)

1 Could you outline what topics are taught in Science at each year level in 1976?

2 What curriculum materials are used at each year level?

3 Is this markedly different from 1975? If so, how and why has there been a change?

4 How do you communicate to the other members of the science staff on what is to be taught?

5 What ASEP units are being used at each year level in 1976?

6 Is this a marked change from 1975? If so, why?

Section II. (To all science teachers and the laboratory assistant(s))

7 Are there ASEP materials in the school, or on order?

8 If so, when was the decision first made to purchase some units?

9 Can you recall which teacher, or which group of teachers were involved in the decisions?

10 Was there a key factor or key person in making the decision to buy ASEP?

11 Are the decisions on purchasing new textbooks and curriculum materials made in the same way?

12 Have there been subsequent orders for ASEP units since the first? If so, what have been the major factors which influenced these decisions?

13 (If 'no' to Q7) - What curriculum materials are being used? How were they chosen? Why has there been no purchase of ASEP?

Section III. (To all science teachers and the laboratory assistants(s))

14 How many years have you worked at this school?

15 How would you describe the 'working atmosphere' in the science department

- i between teachers and staff?
- ii between teachers and support staff?
- iii between teachers and the Principal?

16 What is the extent of contact between science staff and advisers? Have these contacts been useful in planning the curriculum, particulary the implementation of ASEP?

Section IV. (To teachers who have used ASEP units)

17 How long have you been using ASEP materials in your teaching?

18 Has your attitude to teaching Science changed since you commenced using ASEP?

19 What, if any, are the problems you have encountered in using the units?

20 Have there been any consequences arising from using the materials which you did not expect to occur?

21 Do students in your classes use the record books? What is your opinion of them?

22 Are the materials, both textual and apparatal, organized for easy access and use?

23 Have there been any major obstacles which have prevented you using the ASEP materials more?

APPENDIX 5/10

CHECKLIST FOR ASSESSMENT OF IMPLEMENTATION OF ASEP MATERIALS

			Comments
1. Selection of Units			
Stage One Units used in Years Seven/Eight	Yes	No	
Stage Two Units used in Years Eight/Nine	Yes	No	
Stage Three Units used in Years Nine/Ten	Yes	No	
2. Resource Materials			
Teachers' Guides purchased for the units implemented	Yes	No	
Student Texts purchased for the units implemented	Yes	No	
Record Books purchased for the units implemented	Yes	No	
3. Background Data on Students			
Intellectual Levels of learning sequences used to plan lessons	Yes	No	
Reading levels of learning sequences used to plan lessons	Yes	No	
4. Organisation			
Core and option system used	Yes	No	
Student enquiry the basis for learning	Yes	No	
Student self-administers test	Yes	No	

APPENDIX 6/1

ALLOCATION OF UNITS BY STAGE LEVEL, DATE OF PUBLICATION AND SUBJECT TITLE

	Physical or Biol. Sciences (PB)		Earth Sciences or Cross Disciplinary (GC)	
Stage One (N=16)				
	112	Plants	106	Made to Measure
	115	Water	114	Tuning in with the Senses
	103	Electric Circuits	116	World of the Soil
Early (E)	105	Forces	111	Places for People
	108	Mice and Men		
	101	Cells	107	Males and Females
	110	Pigments and Acidity	102	Earth's Changing Face
Late (L)	104	Energy and Change	113	Safety in Science
Stage Two (N=13)				
	201	Atoms	203	Digging up Evidence
Early (E)	206	Light Forms Images	211	Skin and Clothes
	205	Life in Freshwater		
	204	Food		
	208	Microbes	213	Weather
Late (L)	202	Change	212	Sticking Together
	207	Machines	210	Signals Without Words
			209	Petroleum
Stage Three (N=12)				
	304	Genetics	305	How Many People
Late (L)	310	Solar Energy	309	Seashores
	307	Metals	306	The Human Machine
	308	Polymers	311	Traffic
			303	The Earth
			302	Australian Scene
			312	Where Did Humans Come From
			301	Australians Past and Present

APPENDIX 6/2(a)

SALES OF STAGE ONE ASEP MODULE PACKS

Unit No.	Name	Stage Order	Date First Available	Jan.75	Dec.75	Feb.77	Type (PB or GC)	Publication Date (E or L)	Overall Rank 1.2.77
101	Cells	1	Aug.74	9.9	21.2	27.4	PB	L	1
112	Plants	2	May 74	9.4	19.3	26.0	PB	E	2
115	Water	3	Jul.74	8.0	19.3	25.8	PB	E	3
103	Electric Circuits	4	Jun.74	8.7	18.0	25.0	PB	E	4
105	Forces	5	Feb.74	10.0	18.4	24.7	PB	E	5
107	Males and Females	6	Oct.74	4.9	15.3	24.3	GE	L	6
108	Mice and Men	7	Jun.74	10.0	17.9	23.8	PB	E	7
106	Made to Measure	8	Jul.74	6.9	13.7	19.5	GC	E	11
114	Tuning in With Senses	9	Jul.74	9.8	14.5	19.0	GC	E	13
110	Pigments and Acidity	10	Jan.75	4.7	10.2	18.0	PB	L	14
116	World of the Soil	11	Jul.74	8.7	13.4	17.5	GC	E	15
104	Energy and Change	12	Nov.74	4.6	10.5	16.7	PB	L	18
109	Minerals and Crystals	13	Nov.74	3.9	9.0	14.4	PB	L	23
102	Earth's Changing Face	14	Nov.74	3.9	8.9	13.6	GC	L	28
113	Safety in Science	15	Jan.75	3.4	7.6	12.7	GC	L	30
111	Places for People	16	Jul.74	4.5	8.5	11.2	GC	E	33
	Mean			7.0	14.1	20.0			

Note: PB: Units with titles implying content in physical or biological science fields.
GC: Units with titles implying content in earth science or cross-disciplinary fields.
E: Units published before August 1974.
L: Units published after August 1974.

APPENDIX 6/2(b)

SALES OF STAGE TWO ASEP MODULE PACKS

Unit No.	Name	Stage Order	Date First Available	Jan.75	Dec.75	Feb.77	Type (PB or GC)	Publication Date (E or L)	Overall Rank 1.2.77
201	Atoms	1	May 74	8.0	15.9	23.6	PB	E	8
206	Light Forms Images	2	Jun.74	9.5	16.3	22.1	PB	E	9
205	Life in Freshwater	3	Jul.74	9.8	14.2	19.0	PB	E	12
203	Digging up Evidence	4	Jul.74	8.2	13.2	17.5	GC	E	16
211	Skin and Clothes	5	May 74	10.0	12.7	17.0	GC	E	17
204	Food	6	Jul.74	4.7	11.0	16.7	PB	E	19
208	Microbes	7	Nov.74	3.2	8.7	14.4	PB	L	24
202	Charge	8	Aug.74	5.1	9.8	14.1	PB	L	25
207	Machines	9	Aug.74	3.8	9.4	14.1	PB	L	26
213	Weather	10	Oct.74	3.0	8.8	14.1	GC	L	27
212	Sticking Together	11	Sep.74	3.5	7.5	10.8	GC	L	34
210	Signals Without Words	12	Nov.74	2.5	6.4	9.6	GC	L	37
209	Petroleum	13	Jan.75	1.1	6.1	9.2	GC	L	39
	Mean			5.6	10.8	15.6			

Note: PB: Units with titles implying content in physical or biological science fields.
GC: Units with titles implying content in earth science or cross-disciplinary fields.
E: Units published before August 1974.
L: Units published after August 1974.

APPENDIX 6/2(c)

SALES OF STAGE THREE ASEP MODULE PACKS

Unit No.	Name	Stage Order	Date First Available	Jan.75	Dec.75	Feb.77	Type (PB or GC)	Publication Date (E or L)	Overall Rank 1.2.77
304	Genetics	1	Oct.74	5.1	14.0	20.0	PB	L	10
310	Solar Energy	2	Nov.74	6.8	9.4	16.4	PB	L	20
307	Metals	3	Dec.74	2.3	9.2	15.8	PB	L	21
305	How Many People?	4	Oct.74	4.5	11.0	14.9	GC	L	22
309	Seashores	5	Nov.74	5.9	9.8	12.7	GC	L	29
306	The Human Machine	6	Oct.74	3.3	8.1	12.4	GC	L	31
308	Polymers	7	Oct.74	4.5	7.7	12.3	PB	L	32
311	Traffic	8	Nov.74	2.5	6.4	10.1	GC	L	35
303	The Earth	9	Aug.74	3.8	6.2	10.0	GC	L	36
302	Australian Scene	10	Oct.74	2.7	5.8	9.2	GC	L	38
312	Where Did Humans Come From?	11	Oct.74	3.4	6.4	8.4	GC	L	40
301	Australian, Past and Present	12	Dec.74	2.2	4.8	6.5	GC	L	41
	Mean			3.9	8.2	12.4			

Note: PB: Units with titles implying content in physical or biological science fields.
GC: Units with titles implying content in earth science or cross-disciplinary fields.
E: Units published before August 1974.
L: Units published after August 1974.

APPENDIX 7/1

USE OF SCIENCE TEXTBOOKS AND CURRICULUM MATERIALS IN SCHOOLS IN WESTERN AUSTRALIA, 1975

	Year 8		Year 9		Year 10	
Percentage of all science teachers	(65)		(68)		(71)	
Numbers of teachers recorded in parenthesis	A	B	A	B	A	B
Activities in Science (Arnold and others)	-	-	-	-	-	-
ASEP materials	8	3	4	7	1	3
Concepts of Science (Cull and Drake)	1	1	1	1	-	1
Discovery in Science (Eberhard and others)	-	1	-	1	-	1
In Search of Science (Russell and others)	-	1	-	1	-	-
Introduction to Science (Boden and others)	1	2	-	1	-	1
JSSP materials	-	1	-	-	-	-
Modern Science A + B (Barrell)	1	3	-	4	1	4
Nuffield materials (any)	1	3	1	3	1	2
Science for High School Students (Messel)	2	2	1	2	-	2
Science for Secondary Schools (Heading)	18	4	15	4	15	7
Science for the 70s (Mee and others)	-	1	1	-	1	-
State Education Department Materials	79	4	81	4	80	4
Teacher-made materials	24	10	25	12	20	13
Other(s) please specify:	11	3	15	6	19	7
ISCS materials	(4)	(-)	(2)	(-)	(3)	(2)
Inquiry and Response in Science	(2)	(-)	(-)	(2)	(-)	(2)

A: Used the equivalent of one term or more.

B: Used, but less than one term.

APPENDIX 7/2

USE OF SCIENCE TEXTBOOKS AND CURRICULUM MATERIALS IN SCHOOLS IN QUEENSLAND, 1975

	Year 8		Year 9		Year 10	
Percentage of all science teachers	(61)		(58)		(56)	
Number of teachers recorded in parenthesis	A	B	A	B	A	B
Activities in Science (Arnold and others)	3	12	1	6	5	4
ASEP materials	15	15	15	8	3	8
Concepts of Science (Cull and Drake)	4	-	3	-	3	1
Discovery in Science (Eberhard and others)	2	4	1	6	1	3
In Search of Science (Russell and others)	13	3	12	3	15	-
Introduction to Science (Boden and others)	1	1	-	-	1	1
JSSP materials	18	12	6	6	1	1
Modern Science A + B (Barrell)	10	8	13	9	27	6
Nuffield materials (any)	-	4	1	1	-	-
Science for High School Students (Messel)	-	-	1	1	-	1
Science for Secondary Schools (Heading)	16	3	18	2	11	2
Science for the 70s (Mee and others)	1	1	-	1	1	-
State Education Department Materials	-	-	1	2	2	2
Teacher-made materials	13	17	14	10	16	8
Other(s) please specify:	22	9	28	6	30	7
Man and Nature (Stannard)	(10)	(-)	(2)	(-)	(6)	(-)
Exploring the Sciences (Dansie)	(2)	(-)	(7)	(-)	(15)	(-)

A: Used the equivalent of one term or more.

B: Used, but less than a term.

APPENDIX 7/3

USE OF SCIENCE TEXTBOOKS AND CURRICULUM MATERIALS IN SCHOOLS IN TASMANIA, 1975

	Year 7		Year 8		Year 9		Year 10	
Percentage of all science teachers	(56)		(63)		(69)		(65)	
Numbers of teachers recorded in parenthesis	A	B	A	B	A	B	A	B
Activities in Science (Arnold and others)	1	18	4	14	8	14	7	12
ASEP materials	38	35	43	33	34	31	33	26
Concepts of Science (Cull and Drake)	1	8	2	2	1	5	1	5
Discovery in Science (Eberhard and others)	6	19	2	20	9	23	6	14
In Search of Science (Russell and others)	3	10	4	13	3	10	2	10
Introduction to Science (Boden and others)	2	20	7	22	6	18	3	13
JSSP materials	42	38	41	32	1	13	1	6
Modern Science A + B (Barrell)	2	4	4	8	2	9	4	6
Nuffield materials (a [illegible])	3	10	1	8	5	10	7	10
Science for High School Students (Messel)	2	4	1	6	1	6	1	6
Science for Secondary Schools (Heading)	-	12	3	12	3	8	4	8
Science for the 70s (Mee and others)	3	12	1	13	-	5	-	2
State Education Department Materials	2	11	2	9	3	10	3	9
Teacher-made materials	24	29	22	29	27	28	31	21
Other(s) please specify:	7	12	5	11	20	15	29	13
ISCS materials	(-)	(1)	(-)	(2)	(4)	(4)	(5)	(3)
Introduction to Biology (McKean)	(-)	(1)	(1)	(1)	(3)	(4)	(4)	(4)
Science Makes Sense	(1)	(2)	(-)	(2)	(-)	(2)	(-)	(1)

A: Used the equivalent of one term or more.

B: Used, but less than one term.

APPENDIX 7/4

USE OF SCIENCE TEXTBOOKS AND CURRICULUM MATERIALS IN SCHOOLS IN SOUTH AUSTRALIA, 1975

	Year 8		Year 9		Year 10	
Percentage of all science teachers	(56)		(63)		(55)	
Number of teachers recorded in parenthesis	A	B	A	B	A	B
Activities in Science (Arnold and others)	1	12	13	28	19	24
ASEP materials	34	31	34	29	34	32
Concepts of Science (Cull and Drake)	-	3	-	2	-	3
Discovery in Science (Eberhard and others)	21	23	14	22	13	26
In Search of Science (Russell and others)	41	29	46	27	36	28
Introduction to Science (Boden and others)	2	3	1	3	-	1
JSSP materials	17	27	9	15	4	14
Modern Science A + B (Barrell)	-	-	-	-	-	-
Nuffield materials (any)	-	3	-	4	-	5
Science for High School Students (Messel)	1	1	1	2	2	3
Science for Secondary Schools (Heading)	22	24	24	19	27	21
Science for the 70s (Mee and others)	-	3	-	-	-	-
State Education Department Materials	1	3	1	2	1	1
Teacher-made materials	28	15	27	20	29	20
Other(s) please specify:	10	3	6	5	10	6

A: Used the equivalent of one term or more.

B: Used, but less than one term.

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APPENDIX 7/5

USE OF SCIENCE TEXTBOOKS AND CURRICULUM MATERIALS IN SCHOOLS IN VICTORIA, 1975

	Year 7		Year 8		Year 9		Year 10	
Percentage of all science teachers	(44)		(45)		(52)		(51)	
Number of teachers recorded in parenthesis	A	B	A	B	A	B	A	B
Activities in Science (Arnold and others)	2	9	2	11	6	8	3	6
ASEP materials	42	37	41	22	40	19	21	18
Concepts of Science (Cull and Drake)	5	7	-	10	5	8	6	3
Discovery in Science (Eberhard and others)	1	22	2	23	9	23	21	22
In Search of Science (Russell and others)	4	15	4	18	8	13	4	9
Introduction to Science (Boden and others)	2	11	2	12	2	8	1	5
JSSP materials	21	23	22	19	6	4	1	2
Modern Science A + B (Barrell)	-	3	-	7	1	4	1	3
Nuffield materials (any)	1	5	1	6	2	4	4	5
Science for High School Students (Messel)	2	3	3	8	3	8	3	5
Science for Secondary Schools (Heading)	4	16	6	23	8	20	8	16
Science for the 70s (Mee and others)	7	11	8	7	4	8	-	3
State Education Department Materials	3	7	2	6	4	7	7	7
Teacher-made materials	24	25	26	30	26	24	38	18
Other(s) please specify:	9	11	8	12	13	10	15	12

A: Used the equivalent of one term or more.

B: Used, but less than one term.

APPENDIX 7/6

USE OF SCIENCE TEXTBOOKS AND CURRICULUM MATERIALS IN SCHOOLS IN NEW SOUTH WALES, 1975

	Year 7		Year 8		Year 9		Year 10	
Percentage of all science teachers	(70)		(77)		(78)		(76)	
Number of teachers recorded in parenthesis	A	B	A	B	A	B	A	B
Activities in Science (Arnold and others)	1	7	2	10	2	7	1	8
ASEP materials	26	27	22	28	25	22	23	21
Concepts of Science (Cull and Drake)	19	17	20	18	19	18	14	15
Discovery in Science (Eberhard and others)	1	6	1	8	2	9	1	10
In Search of Science (Russell and others)	2	3	1	2	1	1	-	-
Introduction to Science (Boden and others)	8	26	9	23	8	19	6	15
JSSP materials	17	17	15	17	4	17	5	10
Modern Science A + B (Barrell)	1	1	-	-	-	-	-	-
Nuffield materials (any)	2	4	1	3	1	4	3	5
Science for High School Students (Messel)	9	28	23	28	26	32	29	35
Science for Secondary Schools (Heading)	2	1	2	2	2	1	1	2
Science for the 70s (Mee and others)	3	8	2	6	1	5	-	4
State Education Department Materials	5	4	6	4	6	3	4	6
Teacher-made materials	20	24	25	22	30	19	30	21
Other(s) please specify:	15	6	18	10	18	11	15	7
Advancing with Science	(1)	(1)	(1)	(1)	(1)	(3)	(7)	(3)
Clearaway Books	(5)	(1)	(6)	(3)	(7)	(3)	(2)	(2)

A: Used the equivalent of one term or more.

B: Used, but less than one term.

APPENDIX 7/7

AGE OF SCIENCE TEACHERS

OCTOBER, 1975

	VIC	QLD	SA
24 years or younger	18	28	32
25 - 26	18	18	17
27 - 29	18	19	16
30 - 40	29	29	25
41 years or older	16	7	11
	100	100	100
Mean	31.9	29.9	29.5
SD	9.5	6.8	14.4

Note: Means and standard deviations calculated from ungrouped data.

Figures in the body of the Table are percentages.

APPENDIX 9/1

VARIABLES USED IN THE CLUSTER ANALYSIS OF CHAPTER NINE

Variables Related to the Commitment of Schools to ASEP Materials

Variable	School or Teacher Variable	Structure of Variable
1 Adoption of ASEP 1974	S	Total module packs owned by the school up to 31 December 1974, converted for school size. (Figures are module packs per two students studying science in Years 7-10.)
2 Adoption of ASEP 1975	S	Total module packs bought by the school in the period January 1975 - 1 October 1975, per 500 science students.
3 Adoption of ASEP 1976	S	Total module packs bought by the school in the period 1 October 1975 to 1 February 1976 per 500 science students.
4 Use of ASEP 1975: Year 7 5 Use of ASEP 1975: Year 8 6 Use of ASEP 1975: Year 9 7 Use of ASEP 1975: Year 10	T	Three-point scale of use. Teachers asked to indicate equivalent number of terms of use. Aggregation over all science staff teaching at a given level in each school.
8 First Use of ASEP	T	Five-point scale. Higher values correspond to earlier use.

Variables Related to the Innovation Climate

Organisation

1 View Scale	T	Trialled scale of seven items. Designed to measure degree to which resources are effectively used by science staff.

Variable	School or Teacher Variable	Structure of Variable
Cooperation		
2 View Scale	T	Trialled scale of six items. Designed to measure degree to which teachers work together as a group in the administration of the science department.
Openness		
3 View Scale	T	Trialled scale of six items. Designed to measure degree to which teachers show a desire to try new ideas.
Interaction		
4 Activities Scale	T	Trialled scale of seven items. Designed to measure degree to which teachers are linked to outside resources and other users.
5 Knowledge of the Innovation	T	Trialled scale of eight items.